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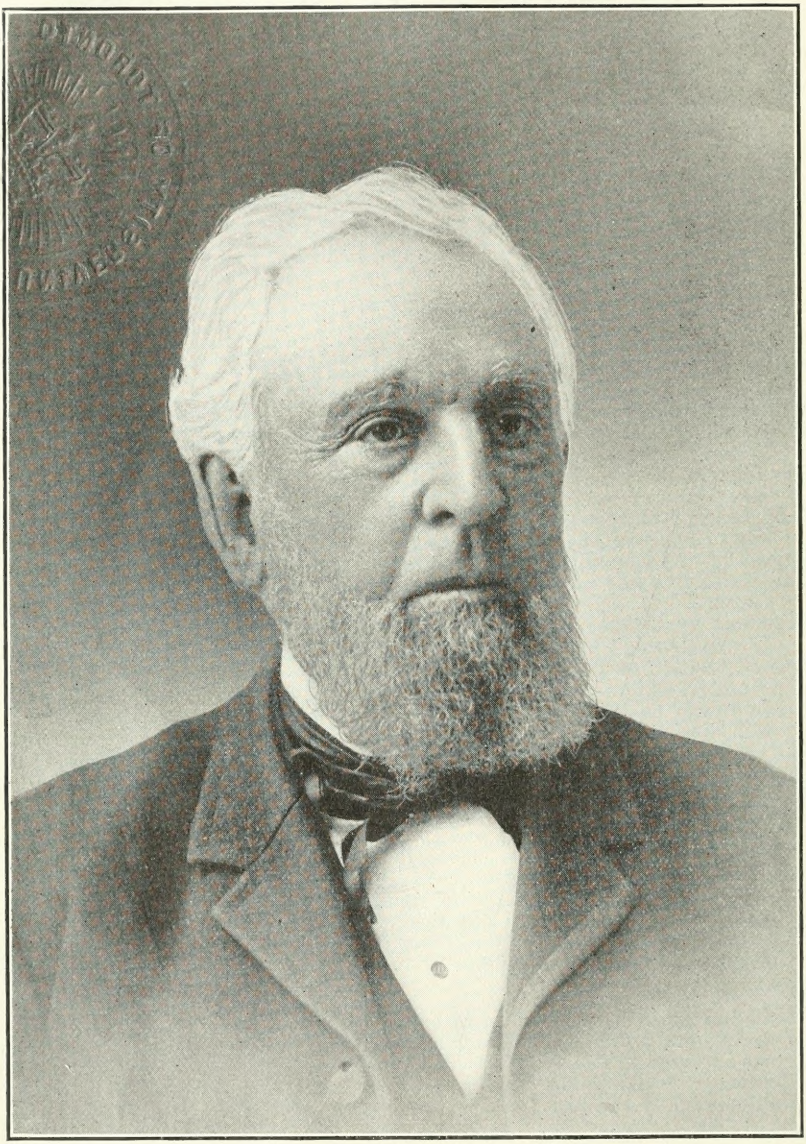


T. L. Miller

THE AMERICAN BREEDERS MAGAZINE

"He was of those whose skill assigns the prize
For creatures fed in pens, and stalls and sties;
And who in places, where improvers meet
To fill the land with fatness, had a seat;
Whose plans encourage, and who journals keep,
And talk with lords about a breed of sheep."—CRABBE.

Vol. II **First Quarter, 1911** **No. 1**

MILLER, DRYDEN, AND WARFIELD

The introduction into America of the various breeds of pedigreed live stock would make an interesting chapter both of the history and the philosophy relating to breeding.

Most of these breeds have come from Great Britain and the British Isles, and almost entirely through private initiative. What public aid was extended consisted in permitting the entry of breeding stock free of duty. In many cases the introduction of a new breed has been made in the face of opposition. The American breeders have rather depended upon the Old World to originate different breeds of live stock, and with a comparatively few exceptions have not originated breeds in either the United States or Canada.

Many men have gained prominence through the work of improving pedigreed animals from Europe and in winning for them a place in the live-stock production of this country. Others have gained prominence and wealth through making those slower improvements which come with small gradual changes after a breed has been originated. Not a few of these breeders were gifted and many sided and combined authorship and other public work relating to the improvement of our live stock with their farming and their breeding of pedigreed live stock.

As to why the British Isles should have been so active in developing breeds and the United States and Canada should have so nearly confined their efforts to widely utilizing these breeds is not wholly a puzzle. In England, for example, the live-stock growers of a county, having gotten into the habit of showing the best of their flocks at the county fair, are in reality in a community group almost as if

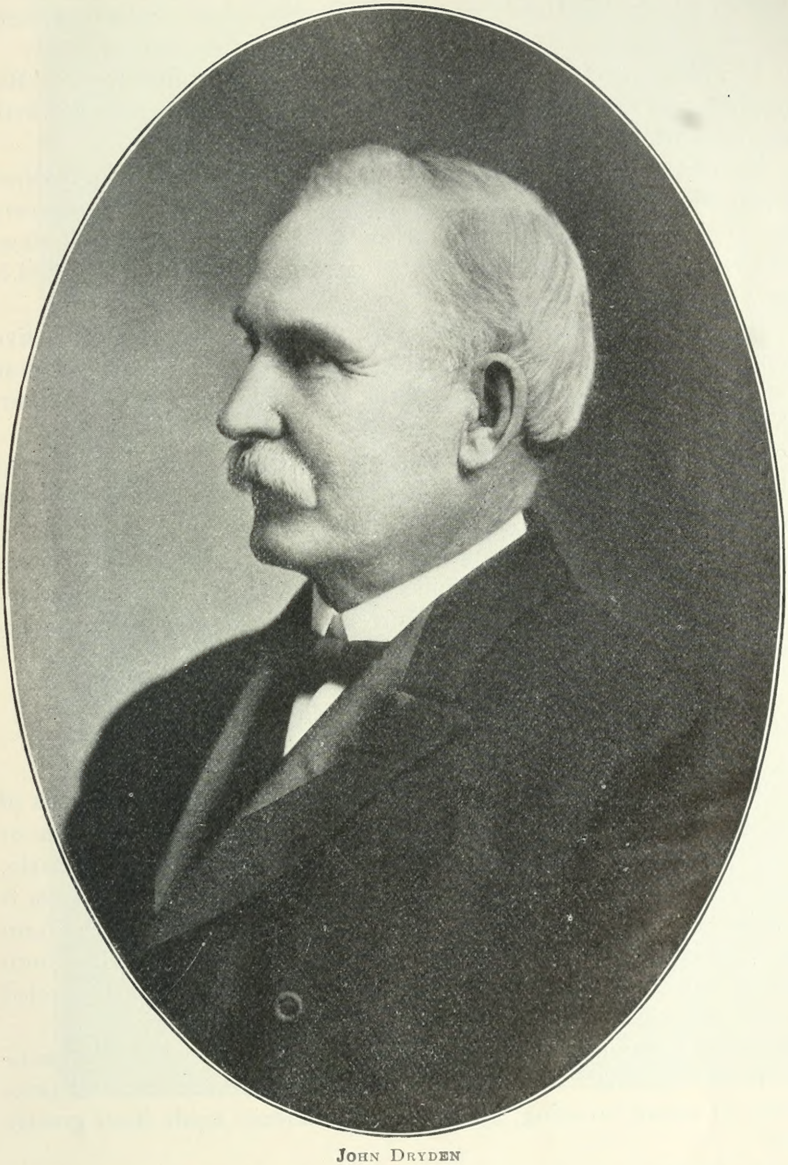
they were coöperating. If any outstanding animal gained a reputation for remarkable progeny this fact was clearly brought out at the county fair and all the other breeders would seek some of his get to try out in their own herds. If great excellence in the second generation of this progeny again proved the mutating excellence of a given sire, or dam, the whole countryside would begin to take an interest in that particular strain of blood. In this way, decade by decade, new breeds with high power to project their qualities into purebred or grade progeny were built up.

These breeds made the British Isles the most famous live-stock center in the world. They brought fine profits to the farmers and breeders through the sale of purebred animals for export to the United States, Australia, Argentine, and many other countries. These breeds provided even a larger profit through the splendid live stock they furnished for the farmers of the Islands themselves. And the success which came from gaining recognition for the most skillful breeding done in the world, as evidenced by the high prices paid by foreign visitors for British live stock and by the high profits on the live-stock farms of those Islands, gave an inspiration to country life which has done much to build up the rural people.

T. L. MILLER

1817–1900

One of the men who have to their credit the chief honor of introducing, against opposition and every conceivable form of difficulty, a valuable breed of live stock was T. L. Miller, of Beecher, Ill. Following Mr. Wm. H. Sotham, the pioneer importer and breeder of Hereford cattle, he became a great champion of this rival breed of the theretofore nearly dominant Shorthorn. Those interested in the different families of Shorthorns could see no good in the new breed. In shows, in the sales ring, and in the agricultural and live-stock press there arose a heated contest. During the eighties this contest waged especially strong. In those days these two breeds were striving for the market for purebred males with which to grade up the then rapidly extending ranch cattle of the short-grass country east of the Rocky Mountains. That market placed no premium on dairy products. The dual-purpose tendencies of the Shorthorn placed it rather at a disadvantage as compared with the Hereford, and to the everlasting loss of the Shorthorn breed the contest with the Hereford for supremacy on the plains caused Shorthorn breeders to



John Dryden

give relatively too much prominence to the blood of Cruikshank's wonderfully mutant sire, Champion of England, until now it is difficult to find in the United States enough Shorthorns with real dairy heredity to serve as a base of a dairy Shorthorn sub-breed.

Mr. Miller had no intention of injuring the Shorthorn breed. His purpose was to introduce and improve the Hereford breed, and with an indomitable energy he labored at that task.

He wrote much for the agricultural papers. For a time he published a periodical devoted especially to Herefords. For a number of years he published the American Herd Book of Hereford Cattle, and when this enterprise grew too large to be carried on privately he turned it over to the Hereford Society.

He wrote a "History of Hereford Cattle," a book of some five hundred pages, finishing that task just before his death. This book was published by Mr. T. F. B. Sotham, son of his old-time coworker, Wm. Sotham.

Mr. Miller was born in New England, but not on a farm; he learned the trade of a butcher, engaged in commercial operations, and later was successful in the insurance business in Chicago. He seems to have wearied of city life, and settled on a farm of a thousand acres at Beecher, Ill., some thirty miles from Chicago. He is an instance of those whose business talents assure success in whatever they undertake, farming not excepted.

JOHN DRYDEN

1840-1909

One of the men who labored to improve our imported breeds of pedigreed live stock, almost to the point of creating new breeds or sub-breeds, was John Dryden, a native of the Province of Ontario, who became a very successful farmer near Toronto. Of his farm it has been said that it was "the best worked and best operated farm in America." His farm specialties were the breeding of Shorthorn cattle and Shropshire sheep. His breeding work constantly tended in the direction of a more scientific system of breeding.

Through that period of Shorthorn history during which the sentiment for "fashion" often overshadowed the more fundamental principles of sound breeding, his steadying influence made itself greatly felt.

Mr. Dryden served as president of the American Shropshire Registry Association, also as president of the Dominion Shorthorn Breeders Association, although his most important public work was

William Warfield

as Minister of Agriculture for Ontario during the years 1890 to 1906. During that period he was a leader of much of the agricultural development of the province, and especially along live-stock lines. It was he who, during his administration, encouraged the development of the bacon breeds of hogs in that province, and especially the improved Yorkshires, with the result that methods of breeding and handling to produce bacon of high quality were successfully worked out.

Mr. Dryden and his associates, through the Guelph winter live-stock show, where prizes were given not only for live animals but also for carcasses showing high bacon type, remarkably improved these breeds from the standpoint of the breeder who seeks the long, uniform side of bacon with its alternating layers of lean and fat.

This work, done in relation to the Canadian effort to lead in foreign markets for bacon, stands out as one of the remarkable achievements in American live-stock breeding.

Mr. Dryden's many friendships in the States attested his lovable character and formed one of the innumerable ties between the two countries.

WILLIAM WARFIELD

1827–1907

One of the characters most prominent during the years in which Kentucky supplied much of the Shorthorn blood to the breeding herds of this famous breed throughout the United States was William Warfield of Lexington, Kentucky.

Mr. Warfield came of old Maryland stock, his grandfather, Elisha Warfield, having migrated from Annapolis, Maryland, and settled near Bryant Station, famed from the days of Boone. There he began the breeding of Shorthorns and fine horses. His son Benjamin, father of William Warfield, though he studied to practice medicine, found the love of the farm and of live stock so strong that he forsook medicine for the breeding of Shorthorns, establishing his herd in 1826.

William Warfield's education was also thorough, including a partially completed course in medicine. Again the taste for rural pursuits and the love of cattle decided the son upon a career upon the land. His farm, "Grassmere," in the bluegrass region, the farm on which he was born, became the seat of his life activity as a breeder of Shorthorn cattle. His most active period was during the seventies and eighties, when the farmers of Kentucky, Ohio, and westward began extensively to improve their stock by the use of purebred cattle and many established herds of pedigreed Shorthorns.

Mr. Warfield stands out as one of the best informed men on Shorthorn history and Shorthorn pedigrees. He contributed much to live stock and especially to Shorthorn literature, and his fund of information was at all times at the command of those who were in need of assistance.

His two most notable contributions to live-stock literature were the books "History of Improved Shorthorn Cattle" and "The Theory and Practice of Cattle Breeding."

He was a strong believer in the possibility of improving Shorthorns and other live stock in our own country. He placed great emphasis upon the possibilities of breeding as compared with continuous importation.

Among Kentucky's many leading live-stock farmers, Mr. Warfield stands prominently as one of a race of noblemen of strong and lofty character. As his ancestors by the force of their character were leaders in their communities, so he was respected, honored, and loved by that wider circle which knew him through the sales ring, the live-stock show, and the printed page.

PROGRESS IN SELECTION AS SHOWN BY ADVANCED REGISTER RECORDS

M. W. Harper

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"Breeding for production in dairy cattle in the light of recent advances in the study of inheritance" is the subject of a very interesting paper recently from the pen of a well-known biologist.[1] The paper calls to our attention some very important data for the study of inheritance; data, the economic value of which cannot be easily overestimated, as they affect the production of a useful product. From a biologic point of view they may be of no greater importance than the beard on a head of wheat, the length of a rat's tail, the color of a guinea pig's fur, or the steps of a Japanese dancing mouse, but from a productive point of view they are of very great importance to mankind. The data, such as therein presented, when extended and properly interpreted, seem to offer, in part at least, a solution of the best method of breeding for increased dairy production as well as to throw some light upon a much discussed biologic question, at least so far as the breeding of the farm live stock is concerned. In view of this it seems worth while to give the paper more than passing notice.

It is not the purpose of this paper to enter into a battle of words, to coin new terms or to define old ones, to propose theories of evolution and the like, but to set forth the facts as they exist at the time the data herein are collected. One thing, kindly remember that this article is prepared by a practical breeder. While in evolution time is of no consequence, with the breeder it must be taken by the forelock. The breeder must, therefore, work faster than nature; he cannot make use of the leisurely operating evolutionary methods of nature. The action must be accelerated or its cumulative effect exaggerated.

Source of the data, Jersey Club's Register of Merit.—The paper referred to takes the records of production of Jersey cows as recorded in the Register of Merit, the official organ of the American Jersey Cattle Club, as the data for discussion. In 1903 the Jersey Cattle

[1] Raymond Pearl. "Breeding for Production in Dairy Cattle in the Light of Recent Advances in the Study of Inheritance."

Club began making official tests of Jersey cows and admitting such animals to the Register as could meet the requirement. In 1908, or five years after its establishment, the first volume of the Register of Merit appeared containing the records of 361 cows. The cow is eligible to the Register of Merit on her own performance alone, whereas the bulls are required to have a certain number of daughters in the Register before they can be recorded. The reason for this is obvious, as bulls do not themselves produce milk.

The paper raised the question, "How have the existing *Advanced Registry* cows been bred as a matter of actual fact?" The importance of a correct answer to this question is admitted, for if we are in possession of this knowledge we may breed some more like them. In the paper an attempt was made to obtain information on this question by tabulating the last 162 cows (Register of Merit Nos. 200–361 inclusive). For convenience of study these cattle were divided into four classes according to the possible kinds of mating, with the results shown in the following table:

TABLE 1.—*Breeding of* 162 *Jersey cows in Register of Merit.*

Description of parentage.	Number of Register of Merit cows resulting from stated parentage.	Percentage each form of parentage bears to total.
Sire in Register of Merit; dam in Register of Merit..	11	7
Sire not in Register of Merit; dam not in Register of Merit....	68	42
Sire in Register of Merit; dam not in Register of Merit....	70	43
Sire not in Register of Merit; dam in Register of Merit....	13	8
Total....	162	100

The following conclusions are drawn from the table: "Too much stress should not, of course, be laid on these figures. As they stand they have no great scientific value. They suggest a whole series of questions which need more data for their final solution. *But the only point which it is intended to bring out here is that the practical breeder will have a great deal of difficulty in finding anything in these figures to indicate that he will be likely to produce more heifer calves that will qualify for the Register of Merit if he breeds from only Register-of-Merit stock than he will if he breeds from non-Register-of-Merit stock.*" In this connection there are two more statements to which attention is directed: (1) "The cow in Advanced Registry has shown nothing except that she is a good milker. She may be and too often is absolutely worthless as a breeder." (2) "There have

been many Jersey cows that were greater milk producers than was Figgis or Marina Pogis, but how many of them can produce a son that will get nine or fifteen daughters in the Advanced Registry?"

Jersey cow butter tests.—Not only are the above data incomplete but they are built upon an entirely erroneous assumption; namely, that all Jersey cows outside the Register are poor producers and not in the Register because they fail to meet the requirements. As a matter of actual fact there are many good Jersey cows not in the Register of Merit simply because they have never been tested. They could make the requirements but are not given the opportunity. In this connection it should be remembered that cows from without are continually being tested and brought into the Register of Merit, which will of necessity mean that there are cattle in the Register that do not have Advanced Registry parentage. The percentage of such animals will simply depend on the number admitted from without.

The larger the number of cows admitted from without the smaller will be the percentage with both sire and dam in the Register of Merit. When the Register was established in 1903, it must of necessity follow that all the animals admitted the first few years had neither sire nor dam in the Register. As years go by, the offspring of the cows first admitted make records and are themselves admitted, with the result that after the Register has been in existence for a period of years a good percentage of the cows in the Register of Merit will have parents in the Register also. An extension of the data in the above table will show this.

While the Register of Merit was established in 1903 and hence of recent origin, butter tests among Jersey cows have been made since the seventies, during which time many Jersey cows have been tested and records preserved. Two volumes of these records have

TABLE 2.—*Breeding of* 162 *Jersey cows in Register of Merit.*

Description of parentage.	Number of Register of Merit cows resulting from stated parentage.	Percentage each form of parentage bears to total.	Including butter tested, in earlier records.	
			Number of cows.	Per cent of cows.
Both sire and dam in Register	11	7	57	35
Neither sire nor dam in Register	68	42	39	24
Sire in Register; dam not	70	43	53	33
Dam in Register; sire not	13	8	13	8
Total	162	100	162	100

been published; the first, August 1, 1898, and the second, July 15, 1902. By following back the data for the same 162 cows and taking into account the butter tests, we get Table 2 on opposite page.

A study of the table including Jersey cows with butter tests shows that the per cent of cows with Advanced Registry parents has risen from 7 to 35 while the per cent of cows with neither sire nor dam in the Register has fallen from 42 to 24. With these facts before us it would seem that our chances of getting an Advanced Register heifer from an Advanced Register cow have been much improved. At the same time our chances of getting an Advanced Register heifer from cows without records have diminished.

Holstein-Friesian cows.—During the year 1894 the Holstein-Friesian Association established the Advanced Register, in which are registered individuals of that breed that meet its requirement. Since the establishment of the Advanced Register seventeen years ago, 11,815 cows and 838 bulls have been admitted. With a view to obtaining more information upon the inheritance of milk-producing qualities a study has been made of the breeding of all Holstein-Friesian cows admitted to the Advanced Register during the year ending May 15, 1910. This study included 3,070 cows, of which 2,233 were first records and 837 re-entries; that is, cows increasing a previous record. Classifying the 3,070 cows as before, we have Table 3.

TABLE 3.—*Breeding of* 3,070 *Holstein-Friesian cows in the Advanced Register.*

Description of parentage.	Number of A. R. O. cows resulting from stated parentage.	Percentage each form of parentage bears to total.
Both sire and dam in Register	1,196	39
Neither sire nor dam in Register	710	23
Sire in Register; dam not	770	25
Dam in Register; sire not	394	13
Total	3,070	100

These results are approximately the same as in the extended table No. 2, 39 per cent having both sire and dam in the Register and 23 per cent with neither sire nor dam in the Advanced Register, 25 per cent with sire only and 13 per cent with dam only in the Register.

Holstein cows making 50 per cent above requirements.—As previously stated, there are many cows outside the Advanced Register that if tested would make the requirements, which are very low when com-

pared with high efficiency. Furthermore, there is much variation among cows in the Advanced Register, some barely making the requirements, others attaining much higher efficiency. This suggests the question as to the percentage of high producing cows with Advanced Register parents. This is the real test of efficiency, as the minimum requirements of the Register are not difficult to make. To obtain information on this point all of the cows registered during the year ending May 15, 1910, making 50 per cent more than the requirement have been selected out and are classified in Table 4 below; that is to say, where the requirement is 12 pounds of fat the table includes those making 18 pounds or more.

TABLE 4.—*Breeding of* 1,121 *Holstein-Friesian cows making* 50 *per cent above requirements.*

Description of parentage.	Number of A. R. O. cows resulting from stated parentage.	Percentage each form of parentage bears to total.
Both sire and dam in Register	584	52
Neither sire nor dam in Register	157	15
Sire in Register; dam not	235	20
Dam in Register; sire not	145	13
Total	1,121	100

Here is evidence that, with the requirement increased by 50 per cent, more than half, or, accurately, 52 per cent, of cows making such requirements have both sire and dam in the Advanced Register while only a little over one in six, or 15 per cent, have neither sire nor dam in the Registry; 20 per cent with sire only, and 13 per cent with dam only. This shows clearly that as we raise the requirements the chances of getting an Advanced Register heifer from the outside are quite small while our chances of getting one from one within, if we get one at all, are about one in two.

TABLE 5.—*Breeding of* 168 *Holstein cows making* 100 *per cent abov requirements.*

Description of parentage.	Number of A. R. O. cows resulting from stated parentage.	Percentage each form of parentage bears to total.
Both sire and dam in Register	123	73
Neither sire nor dam in Register	5	3
Sire in Register; dam not	25	15
Dam in Register; sire not	15	9
Total	168	100

Holstein cows making 100 per cent above requirements.—In order to clear this matter up a little more if at all possible, the cows making 100 per cent above the requirements were classified, with results as shown in Table 5 on opposite page:

When the requirements are doubled, 73 per cent of the cows have both sire and dam in the Register while only 3 per cent have neither sire nor dam in the Register. Now, our chances of getting an Advanced Register heifer from the outside are only three in one hundred while our chances of getting one from within, if at all, are almost three in four. Thus it would seem that the time-worn expression "blood will tell" has again proven its right to remain the breeder's watchword.

Holstein-Friesian cows with records as breeders.—Since the assertion was made that the cows in the Advanced Register have shown nothing except that they are good milkers and that they may be and too often are absolutely useless as breeders, it seems worth while to look to the records and determine if possible the exact standing of Advanced Register cows as breeders. While data on this are somewhat difficult to obtain, some idea of the Advanced Register cow as a breeder may be obtained from Table 6, which is a classification of cows that have produced two or more and four or more daughters with records.

TABLE 6.—*Breeding of* 1,999 *and* 172 *Holstein-Friesian cows with two or more and four or more A. R. O. daughters respectively.*

Classification of cows.	Number of cows.	Per cent of cows.
Cows having records and two or more A. R. O. daughters	1,076	54
Cows having no records and two or more A. R. O. daughters	923	46
Total	1,999	100
Cows having records and four or more A. R. O. daughters	122	71
Cows having no records and four or more A. R. O. daughters	50	29
Total	172	100

As shown in Table 6, of the cows with two or more daughters in the Advanced Register, 54 per cent themselves have records, while 46 per cent have no records themselves. If, however, we wish a cow that can produce four or more daughters that can make the Register, the table shows that the chances are about three to one that we will find her in the Advanced Register.

Holstein-Friesian bulls.—As before stated, bulls are admitted to the Advanced Register on the performance of their daughters; that is, when a Holstein bull has four or more daughters in the Register, he is also eligible. During the year ending May 15, 1910, there were 133 bulls admitted to the Register. To aid in the study of transmission of the milk-producing character, these bulls were classified similarly to the cows, resulting in Table 7.

TABLE 7.—*Breeding of* 133 *Holstein-Friesian bulls in the Advanced Register.*

Description of parentage.	Number of A. R. O. bulls resulting from stated parentage.	Percentage each form of parentage bears to total.
Both sire and dam in Register	85	64
Neither sire nor dam in Register	11	8
Sire in Register; dam not	25	19
Dam in Register; sire not	12	9
Total	133	100

It will be seen that 64 per cent of the bulls capable of producing four or more heifers good enough to make the Register have both sire and dam in the Register, while only 8 per cent have neither sire nor dam in the Advanced Register, 19 per cent sire only and 9 per cent dam only in the Advanced Register. This goes to show that if we wish a bull prepotent enough to get four or more heifers in the Register, our chances are much in favor of finding him with both sire and dam in the Register.

Holstein-Friesian bulls in advance of requirements.—As with cows, the requirements admitting bulls to the Advanced Register are not difficult to make. In all 838 bulls have been admitted. The test of efficiency is shown where we raise the requirement. Since the paper referred to raises the question as to the number of cows that can produce sons that will get nine or fifteen daughters in the Advanced Register, nine is first taken as a requirement; then fifteen, and the breeding tabulated with results as in the table below. Again, since getting fifteen daughters in the Register is not very difficult, the standard has been raised to twenty-five or more, then to fifty or more, and lastly to seventy-five or more daughters in the Advanced Register. This should show relative efficiency and if there is anything in selection should demonstrate that fact. The results of such classification show results as follows:

TABLE 8.—*Parentage of sires, each with specified numbers of A. R. O. daughters in Advanced Register.*

	Description of Parentage.	Number of sires.	Per cent of total sires.
251 sires with nine or more A. R. O. daughters each, or 28 per cent of all in Register	Both sire and dam in Register	145	58
	Neither sire nor dam in Register	31	12
	Sire in Register; dam not	46	18
	Dam in Register; sire not	29	12
	Total	251	100
112 sires with fifteen or more A.R.O. daughters each, 13 per cent of all in Register	Both sire and dam in Register	75	67
	Neither sire nor dam in Register	6	5
	Sire in Register; dam not	19	17
	Dam in Register; sire not	12	11
	Total	112	100
43 sires with twenty-five or more A.R.O. daughters each, 5.1 per cent of all in Register	Both sire and dam in Register	31	70
	Neither sire nor dam in Register	0*	0
	Sire in Register; dam not	7	18
	Dam in Register; sire not	5	12
	Total	43	100
14 sires with fifty or more A. R. O. daughters each, 1.8 per cent of all in Register	Both sire and dam in Register	12	86
	Neither sire nor dam in Register	0	0
	Sire in Register; dam not	1	7
	Dam in Register; sire not	1	7
	Total	14	100
5 sires with seventy-five or more A.R.O. daughters each, 0.6 per cent of all in Register	Both sire and dam in Register	5	100
	Neither sire nor dam in Register	0	0
	Sire in Register; dam not	0	0
	Dam in Register; sire not	0	0
	Total	5	100

The results shown in Table 8 are significant. In the first place, it will be noted that 28 per cent of all the bulls in the Advanced Register have nine or more daughters also in the Advanced Register, and that 13 per cent have fifteen or more A. R. O. daughters. In the second place, it is interesting to note how the per cent of bulls with both sire and dam in the Register increases as the requirements are raised. With the requirement placed at 9 A. R. O. daughters, 58 per cent have both sire and dam in the Register, while 12 per cent have neither

sire nor dam, 18 per cent sire only, and 12 per cent dam only in the Register. With the requirement placed at fifteen A. R. O. daughters, the per cent with both sire and dam in the Register has risen to 67, while the per cent with neither sire nor dam has dropped to 5. With the requirement placed at twenty-five A. R. O. daughters, the per cent with both sire and dam in the Register has risen to 70 and there is not a single sire with neither sire nor dam in the Register. In the third place, we note that when the requirement is raised to the maximum, we have all the animals making the requirement with both sire and dam in the Advanced Register.

The number of cattle tested for admission to the Advanced Register is not large. For the past few years only 13 per cent of the Holstein cows and 1.3 per cent of the bulls have been admitted to the Register. This is significant in a study of the data above. When the small number of cows tested and in the Register are taken into account, and the large percentage of high producing animals coming from the Register are considered, the chance of finding a maximum producer from without the Register are not very encouraging. The breeder attempting to produce a Holstein cow with a weekly record of 29 pounds of butter fat, or a bull that can sire 100 A. R. O. daughters, is likely to encounter much difficulty unless he selects parents from the Advanced Register.

In this connection, it may be stated that the Advanced Register plays no part in increasing the production of dairy cows, it neither adds to nor detracts from the production, but is simply an instrument in which records of performance are kept, and from which records of transmitted efficiency can be obtained, nothing more. It is easily possible to build up a strain of high-producing cows without the Register, but practically the same methods that the Register encourages must be employed. The entire matter may be summarized thus:

The Advanced Register contains a record of performance which enables us to know the high-producing from the low-producing cows as well as the cows and bulls likely to get high producers. The low producers are discarded and the high producers are propagated, which procedure, in connection with better care and management, enables us to get still higher producers. Again the low producers are discarded and the high producers propagated, with the result that the average production and the previous maximum production of the race are raised.

Now we are told that this increased production must of course cease when the limit of the physiological activities of the cells is

reached. But who wants to go on record in any hard and fast setting of the metes and bounds that may or may not limit the working of evolution? Believe me, creation is not yet finished. With proper care and under favorable conditions, the cow is likely to adjust herself to the increased demands made upon her system. There are many ways in which this can be done; not least of all is that of increasing the number of producing cells, which is what she actually has done and is doing under domestication.

THE INHERITANCE OF LEFT-HANDEDNESS

H. E. JORDAN

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There is a widespread popular belief that left-handedness is hereditary. When left-handedness appears among a childship,[1] the parents concerned at once trace it to some direct or collateral ancestor. If the known ancestry contains no individual to whom influence may be ascribed, there is occasioned the greatest wonderment. On the other hand, biologists do not seem to believe in a hereditary bias to left-handedness. Otherwise, it would seem, some attempt had long been made to state its principle of "transmission." Gould (1908), who has given much study to the clinical aspects of left-handedness as supposedly connected with unilateral eye-defect, states very emphatically that left-handedness is not hereditary, and takes gratuitous occasion to speak slightingly of "Mendelism."

To the writer there remains no doubt that left-handedness is hereditary (in the sense that offspring resemble ancestors in this characteristic), and that the condition reappears in successive generations. Leading to this opinion is the fact that in his own ancestry, both direct and collateral, as far as he can determine, there is nowhere left-handedness. Moreover, he has the assurance of a number of friends, taking an intelligent interest in the matter, that the same is true of themselves and their ascendants. Furthermore, in a number of cases known to the writer, the condition of left-handedness has reappeared three or even four times (one case) in as many successive generations.

The fact of its reappearance in certain stocks seems well established. What is obscure, and bids fair to so remain for some time to come, due

[1] The word "childship" is used in the sense defined by E. Stainer ("The Hereditary Transmission of Defects in Man." Dissertation. Oxford University Press, 1910) to designate "the family of children resulting from a marriage," p. 5.

mainly, I believe, to the small number of individuals in any one affected family, is the rule or principle governing the reappearance. Nevertheless, the following facts drawn from a study of 78 lineages in which left-handedness is noted, representing the result of a canvas of nearly 3,000 individuals, may suggest a probable state of affairs and perhaps serve as a beginning to an investigation that further study and more data may very appreciably extend and enhance.

CAUSE OF LEFT-HANDEDNESS

This study is only incidentally concerned with the etiology of left-handedness. The purpose of this research is primarily to note the occurrence of this particular variation among the members of certain families and to formulate, if possible, some principle or principles apparently governing its reappearance and distribution in certain lineages. The work aims, moreover, to make a contribution to the general subject of heredity. The characteristic of left-handedness must have a cause, but whatever this may be in terms of structure is of only secondary interest in this connection.

However, it may serve to set the problem a little more clearly, to record that inveterate left-handedness is invariably associated with general left-sidedness, *i.e.*, left-leggedness, left-eyedness, etc. (see Sibley to the contrary); and that the cerebral localization of this function (*i.e.*, movement of left hand) in the sinistro-manual is in the right cerebral hemisphere (next Broca's center in the third frontal convolution), the reverse condition obtaining in the dextro-manual. The proof of these facts was from the field of pathology and was summarized, and confirmed by personal experience, by Wilson in his valuable and interesting pioneer work in 1891. In this same book are discussed, in a most scholarly way, many theories, mostly mechanical, *e.g.*, transposition of viscera, center of gravity theory, etc., formerly held, all of which are satisfactorily disposed of as very manifestly erroneous or only partially explanatory. Wilson attributes left-handedness proximately to a greater development (preponderant size and weight) of the right cerebral hemisphere and cites authorities (both pro and con) and gives his own evidence from a peculiarly favorable case.

The more recent theory of Gould (1908) to the effect that right-handedness follows the generally more perfect development of the right eye, advanced to supplant all former theories, has been shown by Stevens (1908) to be of doubtful verity. It seems more nearly correct to think of right-eyedness as a condition concomitant with

right-handedness and both dependent upon the same or related cause. At any rate the offered proof is not compelling that they are related as cause and effect. And until Gould shall have frankly reckoned with, and satisfactorily met, Stevens's criticism his "theory" remains largely a speculation.

A careful weighing of available evidence regarding the cause of left-handedness (as furnished more particularly by Hyrtl, Wilson, Gould, and Lombroso) indicates a better developed right cerebral hemisphere. This would seem to depend upon a better nutrition and ultimately upon a better blood supply. The final cause—the factor determining the anatomical variation in the condition of the fœtal blood supply—remains an outstanding riddle. The matter which chiefly concerns us here is to determine in what way or ways this factor (or factors) expresses itself. The fact of the existence of a large class of so-called ambidexters of various degrees, as also of degrees of right-handedness and left-handedness, renders more plausible the assumption that these conditions ultimately depend upon various degrees of variations in the more usual vascular arrangement in the cerebral hemispheres.

HISTORICAL

Probably the earliest data regarding left-handedness are those recorded in Judges 20:16 respecting the tribe of Benjamin. Here there were 700 left-handed slingers in a military population of 26,700. This proportion accords very well with the recent statement of Hyrtl to the effect that among the civilized races of Europe left-handedness prevails in the ratio of 2 per cent (Gould puts it at 6 per cent for the United States). Regarding the Benjamites, however, one must remember that the Bible narrative gives no clue as to whether the left-handed slingers were by nature or by training (as a strategic measure) sinistro-manual in war.

In volume 1, book 4, chapter 5 of Sir Thomas Browne's "Vulgar Errors" (H. G. Bohn, Covent Garden, 1836) is given an interesting, more or less absurd, discussion "Of the Right and Left Hand" with a consideration of earlier theories to account for right-handedness, more particularly those of Aristotle (use), Scaliger ("crassitude, and plenitude of blood") and Caelius Rhodiginus (sinistral location of liver). In a footnote is given Signor Zecchinelli's very plausible explanation for the general preference of the right hand, quoted from "Brande's Journal," viz: "For it must have been observed, that when the left arm is long used, or violently exercised, the left

side also of the chest is put more or less in motion, and a consequent and corresponding obstacle produced not only to the free emission of blood from the breast, but also to its progress through the aorta and its ramifications." (I am indebted to Dr. Bennett Wood Green for this early reference.)

Prof. Hyrtl of Vienna has noted a correspondence between the ratio of left-handed persons and the occurrence of certain deviations from the normal arrangement of the blood vessels. "It happens," he says, "in the proportion of about two in a hundred cases, that the left subclavian artery has its origin *before* the right and in these cases left-handedness exists as it also often actually does in the case of complete transposition of the internal organs; and it is found that the proportion of left-handed and right-handed persons is also about 2 to 100" (quoted from Wilson). Wilson points out, however, that the evidence that in other cases an anomalous blood supply (transposition) has been unaccompanied by left-handedness shows that "it is no necessary source of deviation from normal action." Wilson calls attention to four cases referred to by Dr. Pye-Smith (Guy's Hospital, London) where the subject of abnormal disposition of the viscera had been right-handed. Four additional non-conforming cases are cited by Wilson.

Dr. Pye-Smith says: "The opinion that some difference between the two sides of the brain has to do with our preference for the right hand over the left may, perhaps be supported by two very interesting cases of aphasia occurring in left-handed persons, recorded by Dr. Hughlings Jackson and Dr. John Ogle. In both these patients there was paralysis of the *left* side; so that it seems likely that in these two left-handed people the right half of the brain had the function if not the structure which ordinarily belongs to the left." A third case checked at autopsy is reported by Wilson. Case No. 17 of my own material has a similar history, as will be described below.

Wilson believes that left-handedness is due to an exceptional development of the right hemisphere of the brain; "that advantage accrues to all from cultivation of dexterity in both hands; that the right hand is given preference naturally or instinctively by some . . . in a smaller number left-handedness is formed by an equally strong impulse . . . but in the great majority right-handedness is largely the result of education." Garman, in reviewing this book in "The Nation," suggests that the greater development of the left hemisphere may be due to the greater use of the right arm, i. e., cause and consequence are thought of in the reverse order by Wilson.

Furthermore, Garman insists that "it is still an open question whether an organ less developed is more liable to disease," as Wilson urges in support of his idea of the value of the training for ambidexterity. The final settlement of the question regarding the greater development of the right and left cerebral hemispheres in left- and right-handed individuals respectively awaits careful study and measurement of a large series of infants' brains.

Gould, with much reason it would seem, ridicules the "ambidexterity silliness" as provocative of much misery. Common sense alone dictates that where one hemisphere is apparently well capable of controlling a certain range of physical and mental activities, it were a waste of time to cultivate a bilateral control (a possibility often realized when a member of one side of the body is incapacitated). Moreover, when a child at school gives evidence of stronger preferment for using the left hand, it were criminal to handicap and abuse that child by forcing it to use the right hand. His theory, however, that right-handedness is due to a more efficient right eye disregards contradictory neurological facts as pointed out by Stevens.

Lombroso (1903) studied left-handedness from the viewpoint of mental pathology and psychiatry. He calls attention to a widespread belief in the mental and moral crookedness of a left-handed man. His studies led him to the opinion that the left-handed are more agile, and "ordinarily found among women, children, and savages and they were more numerous in past ages than they are now." Among 1,029 operatives and soldiers 4 per cent were left-handed. The ratio among women operatives ranges from 5 per cent to 8 per cent. "Among lunatics the proportion is not much different." Among male criminals 13 per cent are left-handed; and among female criminals 22 per cent. 33 per cent of swindlers are said to be left-handed. The ratio of left-handedness among murderers and ravishers is given as 9 to 10 per cent.

Lombroso studied 44 heads of criminals in the museum at Turin and found the right lobe better developed in 41 per cent; the left lobe in 20 per cent. Ordinarily, Lombroso states, the left lobe takes precedence. "Receiving the blood from the heart more directly and in greater quantities than the right, it is the first to develop from the embryo, works more, and is the more voluminous of the two, the right only serving, one may say, as a help or reinforcement to the other" (p. 442).

Audenino (1907) expresses his opinion that recent researches have shown that left-handedness is more frequent among criminals.

immoral individuals, prostitutes and epileptics, and that children during the first month (Baldwin) are for the most part ambidexterous. Further, that left-handedness is a degenerate characteristic, an atavistic phenomenon (Lombroso; Louis Agassiz also held this opinion). Lombroso says: "But then, what significance has ambidexterity? According to Brinton, the anthropoids are ambidextrous; according to Le Bon ambidexterity is frequent among savages, idiots, and infants. Ambidexterity is likewise frequent among criminals and epileptics; also, it seems to me that many of those which appear left-handed (and left-handed on the dynamometer also) are really ambidextrous; and that ambidexterity, more than left-handedness, represents an atavistic character" (p. 26). He admits that it is not easy to tell in many cases whether one is dealing with a left-handed or a right-handed person. Tested with the dynamometer on successive days subjects (i. e., students, etc.) gave results indicating ambidexterity, right-handedness or left-handedness. This was equally true of individuals who said they were left-handed.

Lattes (1907) notes that cerebral asymmetry is greater in delinquents, children, idiots, and negroes than in normals.

He draws the following conclusions from his investigations:

1. Right-handedness is connected with morphological and functional asymmetry of the brain.

2. There are two kinds of left-handedness:

   (a) Atavistic (constitutional), due to an inversion of normal cerebral asymmetry.

   (b) Pathologic left-handedness (manifested after a left cerebral lesion), which left-handedness is what predominates in epileptics and delinquents.

Touching the matter of hereditary left-handedness the literature is very meager. Wilson states that M. Ribot in his "Heredity" wrote: "There are families in which the special use of the left hand is hereditary. Girou mentions a family in which the father, the children and most of the grandchildren were left-handed. In an instance communicated to Wilson both parents of a gentleman in Shropshire were left-handed. His mother accordingly watched his early manifestations of the same tendency, and employed every available means to counteract it. The left hand was bound up and tied behind him. But all efforts to suppress the impulse were in vain." Weber (1904) argues that the anthropoids, primitive man and the young child (before eight months) are ambidextrous. He suggests that the almost universal choice of the right hand by the growing

child is the expression of a hereditary bias acquired by man during racial development.

Merkel (1904) comes to the conclusion that right-handedness and left-handedness rest upon an heritable originally better organization of the left and right cerebral hemispheres respectively.

On the other hand, Kellogg (1898) claims that right-handedness is due to training and habit. He thinks, moreover, that great benefit accrues to the ambidextrous individual, and urges that training be directed to this end. He cites Brown-Sequard as an eminent scientific advocate of this view. He notes also, in support of his contention, that Leonardo da Vinci and Michael Angelo were ambidextrous. Galippe (1887) and Broca (1888)—cited by Bardeleben—still earlier expressed belief in the educational origin of right-handedness.

As a result of a large series of experiments on his own child from the sixth to her tenth month, Prof. Baldwin (1905) concludes "that dextrality is due to a difference in development in the two hemispheres of the brain, that these differences are *hereditary* [italics my own] and that they show themselves toward the end of the first year" (p. 75). Continuing he says: "It is a singular circumstance that right hand and speech are controlled by the same hemisphere of the brain from contiguous areas. It would explain this—and at the same time it seems probable from other considerations—if we found that the right hand was first used for expression before speech; and that speech has arisen from the setting aside for further development, of the area in the brain first used for the right hand" (p. 76).

In an extensive article of 72 pages, Prof. Karl von Bardeleben (1909) reviews the whole subject of bilateral asymmetry in man and higher animals. More than half of the paper is devoted to a critical comparison and evaluation of various theories advanced to explain unilateral dextrality. The appended bibliography of 186 works is possibly the most complete on the general subject. Bardeleben expresses belief in the hereditary nature of left-handedness (likewise right-handedness), but whether this inborn tendency be localized in skeleton or muscles of arm or in the brain he leaves undecided. Nor does he find any clue as to its phylogenetic origin. He concludes that there is as yet no solution of the phenomenon of right-handedness, adding that "no solution is better than one or several that are erroneous" (p. 56).

He also thinks that "man could only gain if, instead of having only one well-developed hemisphere, he had two, which could be employed not only in case of need, but in the varied employments of daily life"

(p. 43). He opposes the position that right-handedness is due to a better developed left cerebral hemisphere, as supported more especially by Merkel, on the ground that "neurological evidence forces the conclusion that right-handedness is and was the primary condition, the higher organization of the left hemisphere was and is the consequence" (p. 48).

It must be pointed out, however, that the "neurological evidence" here referred to (*i. e.*, use of end-organ reacts developmentally on its brain center) has meaning in this connection only in the event that it can be proved that a primary better blood supply to one or the other hemisphere does not produce a correspondingly greater development. In opposition to the theory as developed by Lueddeckens (1887), that dextrality is due to asymmetry of the large arteries, he argues that also the better blood supply of the left hemisphere is consequence (not cause) of right-handedness (p. 28).

The main support for this opposition seems to be derived from the fact that cases of situs inversus have been recorded coincident with a condition of right-handedness. It must be emphasized, however, that the theory does not necessarily imply complete situs inversus. The blood vascular system is subject to a wide range of variations. A very slight alteration in the more normal arrangement in early embryonic or fœtal life may be sufficient to supply the better nutrition from which a better developed right hemisphere may originate, determining a future left-handed individual.[2]

Bardeleben also introduces an element of confusion in the whole discussion when he speaks of anthropoids as preponderatingly right-

[2] This idea is based upon the anatomical relations of the arteries (internal carotids) carrying the blood to the developing brain. The arrangement, as concerns the arteries involved (internal and external carotids and subclavian), is relatively permanent after the earliest embryonic stages (ca. 5 weeks). Examination of the arrangement of the aortic branches of a 10 mm. human embryo reveals the fact that the most direct course of the blood passing from the left ventricle is up the innominate artery. However, before reaching the internal carotid, the main stream is shunted off into the right subclavian artery. Moreover, the most direct course for the remainder of a particular stream is up the external carotid. It follows, then, that the internal carotid receives a relatively small portion of the blood directed towards the right side. On the contrary, the most direct course for the blood passing to the left side is up the left common carotid, and into the left internal carotid, which thus receives the main stream. As compared, then, with the right, the left internal carotid receives during embryonic and fœtal life a larger amount of blood. Moreover, as compared with the right, the left subclavian artery receives a considerably smaller amount of blood. Thus the combination of vascular conditions favoring the better development of right arm and left cerebral hemisphere may conspire together to produce right-handedness; a reversal or disturbance of such conditions, left-handedness—or the various degrees of ambidexterity. Stronger right arm and better developed left cerebral hemisphere may possibly not be in the relationship to each other of cause and effect (Bardeleben) or the reverse (Wilson), but may both be due to the normal anatomical arrangement of the main branches of the arch of the aorta, determining that these two structures on opposite sides of the body, as compared with their respective comites, shall be better nourished; hence both may really be the combined proximate cause of right-handedness.

handed on the basis of greater development (size and weight) of the right fore-limb. Right-handedness (in the restricted sense in which the term is ordinarily employed) signifies essentially greater dexterity with that hand, or a predominating tendency to use the right hand in executions requiring skill and in delicate manipulations. It seems necessary to make a distinction between functional (deftness) and structural (size and weight) bilateral asymmetry (cf. Weber).

Bardeleben thinks finally that there is no satisfactory anatomical explanation of right-handedness yet forthcoming. "We know as little why we are right-handed, and why a certain proportion of mankind are left-handed, as we are able to state what 'right' and 'left' are, or why there are dextro-rotary and levo-rotary solutions of sugar and other substances, or why some of the planets revolve around the sun and on their own axes from right to left and others in the opposite direction" (p. 36).

The report that certain animals (*e. g.*, lion, camel, parrot, monkey, etc.) are predominantly right or left-handed is probably without foundation in fact. The apparent left-handedness (left-footedness) of parrots, so frequently cited, is a simple matter of imitation and convenience as demonstrated by Dr. David Starr Jordan. Ordinarily parrots are approached in feeding, etc., with the right hand. They most conveniently receive with the left foot. When the left hand is employed in the test, the parrot invariably responds with the right foot.

The several points appearing in this brief survey of the literature upon which my own results may be presumed to bear are (a) left-handedness is localized in the right cerebral hemisphere (Hyrtl, Wilson, Cunningham, Merkel, Baldwin); (b) left-handedness is hereditary (Wilson, Merkel, Weber, Bardeleben; Gould expresses an unqualified denial; also Kellogg); (c) left-handedness occurs more frequently in females than in males (Weber); (d) left-handedness is more frequent among delinquents (Lombroso, Audenino, Lattes); (e) left-handedness is more frequent among negroes (Lattes). The heredity character of left-handedness is the point especially sought to establish in the material and arguments presented below.

GUIDING HYPOTHESES

As my study of left-handed families progressed, the following hypotheses, conforming in general to a Mendelian interpretation, suggested themselves:

(a) Left-handedness (L) and right-handedness (R) are dependent upon a varying anatomical condition; secondarily on the condition of the blood supply (on evidence of the above-named investigators).
(b) R = usual condition, therefore tends to be dominant.
(c) L = variant condition, therefore tends to be recessive.
(d) Ambidexterity (A) = condition of imperfect dominant or "blend."
(e) $R \times L = RL$ = right-handedness or ambidexterity.
(f) $RL \times RL = RR + 2RL + LL = 3R + L$.
(g) $2RL \times LL = 2RL + 2LL$.
(h) $RL \times RR = 2RL + 2RR$.

The final effort was to attempt an interpretation of the 22 family histories respecting which the data were more complete and reliable, in terms of the Mendelian formulæ *d* to *g*. It must be admitted at once that the formulæ fit only selected cases, and in all cases, of course, the character of the parental germ cells can only be inferred. Nonconformity may very likely be due to comparative scarcity of data. There is significance in the fact, I believe, that none of the collected data directly contradict these formulæ.

MATERIAL

The material for this study represents the results of a canvass of the university students (700) and the pupils of the public school (white 1,394, colored 668). The following 24 schemes give the facts regarding the most interesting families. These pedigrees are of university students, of pupils of the white public school, and of the pupils of the colored public school.[3]

DESCRIPTION OF SOME OF THE FAMILIES

Fig. 1. This pedigree shows transmission by a carrier male, and gives a four-generation history of left-handedness.

[3] The following symbols are used in the heredity charts: male, right-handed; female, right-handed; male, left-handed; female, left-handed; male, ambidextrous; female, ambidextrous; sex unknown, right handed; sex unknown, left-handed.

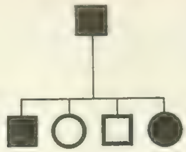

Fig. 2. This childship is interesting mainly for the reason that it shows direct transmission to half the individuals and both the affected and unaffected are equally divided as to sex.

Continuation in next number.

A SYSTEM OF NUMBERING INDIVIDUALS OF THE HUMAN FAMILY

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To one who has had to do with pedigreed live stock where each animal is given in addition to its name a distinctive number for the purpose of exact identification and ready reference, the question naturally occurs whether the same idea of adding a number to the name could not with great advantage be followed in the registering of human births; and for the purpose of exciting a discussion on the subject the following crude scheme is outlined and some of its points considered.

If numbers were added to the name of the individual and the present system of state registers made to center in a national register we would have for the human family of the nation the same accurate and ready genealogical information as is now provided in the case of the better classes of our domestic animals.

The present system of registering by names which are common to numbers of different persons furnishes so little identification as to be almost useless, whilst the amount of work involved is nearly or perhaps quite as great as would be required for the immeasurably more exact and useful system proposed.

At present the registration of births, deaths, and marriages is, in Canada, a provincial institution, under which the local registrar sends in his registrations periodically to the capital of his province. In the United States I presume registration is at present a state institution.

According to the scheme we are proposing it would be a national institution and the local registrars would send in their registrations periodically (say monthly) to the national capital, where numbers would be assigned, the registrations compiled, and copies returned to the local registrars; there would then be two sources of information, namely, the office of the local registrar in each municipality and the office at the national capital. The numbers thus assigned monthly would in a general way be chronologically consecutive with respect to the dates of the births; and this would be convenient but not at all essential.

Assigning numbers to all future births would immediately bring all the coming generation under the system, and all the important part of the present generation would be brought in also, by assigning numbers to the parents at the same time as assigning numbers to the births. Immigrants could be assigned numbers in the same way as births, so soon as they become settled in their new homes; or they could be permitted to remain until they presented births for registration.

A number is itself an index to its own location in every consecutive list; and the system of numbering once established, it is probable that statistical lists intended for reference would then usually or always be made in the order of consecutive numbers, with or without the addition of the names, as the case might call for.

Given any individual's number, the father and mother could be immediately ascertained by reference to the national records, and the exact pedigree established as far back as the records extended.

The numbers which go to this pedigree, having been written down consecutively, could be readily detected in any consecutive list it was desired to search: for instance in the army list, navy list, list of legislators, judges, professional and business men in the various professions and lines of business which keep registers of their members; in the registers of asylums, prisons, tuberculosis and cancer hospitals, etc. Such lists are kept at present but are compiled with names alone, which, as said before, furnish so little identification that one has to have outside information in order to know whether the name when it occurs refers to the individual in question or not. When compiled according to consecutive numbers, these lists could be readily searched, and would furnish exact information.

It is needless to point out the great advantage to the study of eugenics. The way would be opened to the compilation of a great

variety of useful statistics helpful both to those studying eugenics and to those desirous of putting into practice the precepts it teaches.

By his identification number the individual's history could be readily and accurately traced through his school, college, university, military, naval, professional, or business career; assuming that all institutions were then to maintain numerical lists as most of them do now alphabetical lists. One indirect advantage would perhaps be the stimulus to the individual, seeing that his identity was so thoroughly established for all time to come, to make as good a record for himself and his family as he could accomplish; and to have his number appear in as many honorable lists and in as few discreditable lists as possible, knowing that his number wherever it might appear would definitely point to him. He would probably display more care on account of the number which was his exclusive property than on account of the name which he shared in common not only with relatives but probably with many others in no way "connected."

Other points worth considering are: easy identification in the case of legal disputes lost heirs, etc., and the question of advantage to the police. This leads to the consideration of some scheme by which all would be required to furnish their number upon demand; with a penalty for giving a fraudulent number; some further scheme for detecting fraud; and some system providing for the identification of those too ignorant to be entrusted with the keeping of a number. Fraud would have to be contended with then, as now, but fraud in the matter of identity would be more easily detected in the case of numbers, or rather numbers added to names, than in the case of names alone; for it is not proposed to do away with names but to give numbers in addition to names.

Although this scheme for bringing in the whole population would be more complete, more useful, and probably the more easily worked, I would suggest to those who think it too extreme, the consideration of some less comprehensive scheme, say one that might be voluntary; for the usefulness of such registration as is suggested would not be destroyed by reason of its circumscribed adoption. On the contrary its usefulness would be commensurate with the extent of its adoption.

If a bureau were established at the national capital for the purpose of receiving voluntary registrations and of promulgating the scheme, it is probable that national registration would shortly become honorable and sought after. The better classes would feel it an advantage to escape from the ranks of the "unrecorded", to join those who would have a place in the national records and history of their coun-

try; and this would be from the beginning a gain of constantly increasing value.

The less comprehensive scheme, however, does not appear to me as being either so good or so workable as the scheme to bring in the whole population.

There is perhaps no more important subject than that of improving the human race in respect to a sound mind in a sound body, and this subject is being largely discussed at the present time. After discussion should come action; and intelligent action must be founded on reliable information. It appears to me that the system of registration proposed will do more than anything else towards accumulating in the course of time a large fund of the very information desired.

Whatever use future generations may see fit to make of such information, we can at least perform some share of our duty in the great work by endeavoring to accumulate it.

Whilst numbers are so superior to names for the purpose of identification and as an index to statistical compilations, names are no less important, and it might be well to give some consideration to improving our system of nomenclature.

At present, as it is customary for children to be called by the surname of the father, the mother's name is completely dropped out of use, and frequently out of recollection. Our names in consequence only indicate one-half of our immediate ancestry.

A suggestion I would offer for discussion is that our surname should be a compound of the last name of our father preceded by the last maiden name of our mother.

This compound name might be established and the system maintained by requiring it to be written in full in every case where a legal signature is demanded.

The last name of the compound would be adhered to from generation to generation as at present, but the first name of the compound would change in each generation to correspond with the last maiden name of the mother; thus, supposing a Mr. Smith married a Miss Jones, his children would be known as Jones-Smith and the children of his son, say Tom Jones-Smith, who married Miss Casy-Brown would be known as Brown-Smith.

In some of our rural municipalities settled in the early days by a few families who have multiplied and filled the neighborhood, intermarriage between relatives is frequent and is sometimes continued to an undesirable extent; and this is often done without the evil being

recognized by the contracting parties, or their parents, from the fact that there is nothing in the names to show the connection when it comes in on the female side of the pedigree. A McKay may marry a Casy, and on the face of it the union show no fault; but it might be a Casy-McKay marrying a McKay-Casy and under this system of naming a relationship would at once be suggested. If McKay were to marry his cousin McKay, as is not infrequent, and again McKay junior the son of these cousins were to marry in turn his cousin McKay, this last marriage, although much more objectionable than the first, would appear to be about the same; but under the system of naming suggested the first would read, say, Casy-McKay to Jones-McKay, while in the latter case it would read McKay-McKay to say Brown-McKay, or possibly McKay-McKay to McKay-McKay, which would at once draw attention to the likelihood of undesirable consanguinity.

We frequently see now the maiden name of the mother given as a middle name to one of the family, but we seldom see it given to all the children. The question suggested for discussion is, whether it is worth trying to make this method of naming the rule instead of the exception; for it will no doubt be granted that some system that will indicate the mother as well as the father is desirable.

A summary of the suggestions amounts to a number for the purpose of exact identification, etc. a Christian name for familiar use, and a compound surname indicating both the parents.

REPORT OF THE COMMITTEE ON HEREDITY OF EPILEPSY.

WILLIAM N. BULLARD, *Chairman.* EVERETT FLOOD, *Secretary.*
E. E. SOUTHARD. J. MUNSON.

The Committee on Heredity of Epilepsy was notified of its formation in the summer of 1910 and held a meeting very promptly afterward. The situation was discussed and circulars were sent out to those persons who were most competent to give us the information desired.

The four questions asked and the replies received were as follows:

1. Are you acquainted with any instance where a non-epileptic child has come from two epileptic parents? Have these parents also epileptic offspring? Eleven replied in the negative and three in the affirmative.

2. Please give cases you have known where an offspring with one epileptic parent has been free from epilepsy. Facts about children in the family, etc. Six replied in the negative and seven in the affirmative.

3. Can you give one or more instances where an epileptic person can be shown to have had no epileptic inheritance (epileptic, insane, inebriate or allied condition in blood relation as parents, brothers and sisters, grandparents, uncles, aunts, first or second cousins, great-uncles, great-aunts, children? Nine replied in the negative and eleven in the affirmative.

4. Can you cite the case of any epileptic person whose ancestry can be traced with almost absolute accuracy for three generations? Preferably cite cases with two or more epileptics in one family. Eleven replied in the negative and five in the affirmative.

Another consultation of the committee was held and it was thought advisable to try to get more explicit statements from certain ones who answered the questions. This inquiry is now under way.

The results of the work of our field worker have been very satisfactory. It appears that we shall in time be able to trace out certain families in which there is a hereditary tendency to epilepsy.

This work will be carried on and full detailed reports given in due time.

THE KARAKUL BREED OF SHEEP

C. C. YOUNG

Goodnight, Texas

The Arabi or Karakul sheep has its origin in the Khanate of Bokhara, Central Asia, and belongs to the long-wool family from which all broadtail varieties descend. For centuries Arabi bucks have been smuggled into Afghanistan, Persia, Turkestan, China, Palestine, Syria, Asia Minor and Egypt and because of the ignorance of the natives, who seem to have no conception of proper breeding have been crossed with native sheep of the long-wool, short-wool and hairy classes, which in all of those countries belong to the most inferior type of domestic sheep imaginable. Were it not for the fact that the Arabi strain was from time to time injected into the native sheep of the above-named countries, their sheep industry to-day would amount to absolutely nothing. As the Arabi is essentially a desert animal, and able to withstand any amount of hardship, evi-

dently not minding the intense heat in the summer nor the severe cold in the winter, often going for days without food and water, it can readily be seen why the people living in the arid countries of Central Asia found it advantageous to cross their native sheep with the Arabi, which is the heaviest sheep known. The barren semi-mountainous country of Bokhara in which the Arabi thrives certainly does not show much evidence of grass, except here and there

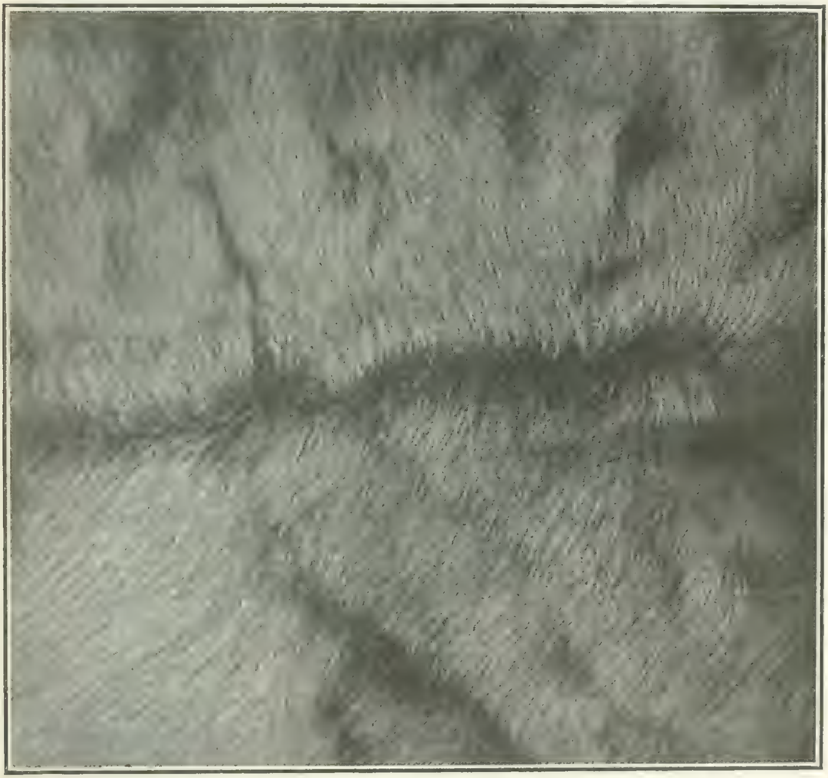

FIG. 1. UNBORN HALF-BREED KARAKUL SHROPSHIRE.
Obtained before fur shows figures. Object was to obtain unborn Karakul-Shropshire velvet with figures.

in the small valleys, and nature has made it possible for this animal to store in a short time large quantities of fat in its immense tail, weighing from 25 to 50 pounds, upon which it draws for sustenance when necessity demands it, and these properties are in a large measure transmitted to the offspring resulting from crossing the Arabi with the native sheep.

One has to eat the mutton of the Arabi but once to realize that it has absolutely no sheepy taste, but possesses a delicious and very appetizing flavor, that has made "shashlik" a famous dish among the epicures of Europe and Asia. When, therefore, an Asiatic possesses a flock of inferior common sheep with the musk-like flavor of the Merino sheep or the goat family, and seeks to get an increase in weight and a hardiness capable of withstanding the intensely cold winters of a country like, say, Afghanistan, he naturally turns to the Arabi family, knowing well that with even a 25 per cent of Karakuld injection this musklike flavor can be overcome.

The Arabi lamb before birth, or a few days after, is a most intensely black-pigmented animal. It has a high luster, giving it the appearance of the richest of black figured velvet, with tight curls more or less evenly distributed. The pigment is practically not affected by the rays of the sunlight, which is, however, not the case with the commercial Arabi fur obtained by crossing the Karakul with common sheep, of which it is absolutely necessary to dye the skins. It is this fact that made Leipzig and its immense dyeing industry famous.

There are two classes of Arabis, the small and the large variety. In my opinion the small Arabi is the original wild, broadtailed sheep, from which all other broadtail varieties originate. They are always born black, and later become gray. The head is narrow and the face elongated; head-line curved with small ears. The feet are thin, as is the case with all wild animals of the ovine class. The tail is not very long, but broad, and triangular in shape, and they are all horned, with whitish spots on the head, tail, feet, and both sides. This sheep is said never to have existed anywhere but in the mountainous section of Bokhara. The tail not being as large as in the large Arabi would explain why these animals have been able to mate without assistance. The animal certainly has the appearance of a wild sheep and in every way resembles it. They are probably a little heavier than the American Shropshire. The large Arabi has a massive head, short face, nose-line bent, ears pendulous and quite large, with thick strong feet, especially the hind legs, with an immense S-shaped tail reaching to the ground, and when they are at all fat the tail drags, and in exceptional cases it has to be supported, which is done by placing it on a two-wheeled cart. Like the small variety, they have stiff hair on the front head and lower portion of all four extremities, but are not horned, nor have they the white spots mentioned of the other variety. Quite often they have auburn lambs. The Tartar

authorities think that this class resulted from crossing the small variety with some big, long-wool short-tailed white or auburn sheep of Bokhara. If that is the case I cannot understand why there is such a difference in the size and shape of the tail. These two classes have been crossed, and in many instances it is almost impossible to select typical specimens representing either class.

FIG. 2. HALF-BREED KARAKUL-MERINO.
A practical fur, but lacking in luster; known in Russia as peasant fur.

The fifteen head which I brought to this country belonged to both classes, and some of them no doubt are crosses between the two, notwithstanding the fact that we have tried hard to avoid such a selection. I have, however, only one ram which comes anywhere near having the enormous tail with which many of the large variety

are encumbered. It is very difficult to drive those with an immense tail and I was afraid of losing them on account of the long trip.

The fur of the smaller Arabi is superior to the other kind, which again strengthens my belief that the small Karakul is the original wild broadtail above mentioned.

On account of the small number of full-blood Arabis (it is estimated that there are not over 5,000 full-blood Arabis in Bokhara) very few of them are ever killed and what few Arabi skins are permitted to be exported seldom ever come into the possession of anyone except the richest classes of the nobility of Asia and Europe; those less fortunate have to content themselves with the commercial furs, such as Persian lamb, Astrakhan, Krimmer, and Afghan (the last is known in America as Karakul). The Afghanistans deserve the credit for producing the first and the best commercial Arabi fur and I am completely at a loss to understand why Persia is getting the credit. It is probably due to the fact that the crafty Persians have for years bought up the best products in Afghanistan and after making a good profit have disposed of them to the European merchants at Tashkend, whence they go to Nishni Novgorod, the old capital of the former Russian republic of Novgorod, whose commerce extended into Turkey, Greece, Persia, and even India at a time when the Teutons and Anglo-Saxons were still barbarians.

The commercial Arabi fur known as Persian lamb, Astrakhan, Krimmer, and Afghan is the result of breeding the Karakul to certain species of common native sheep of Central Asia. The natives have learned from many years of experience that producing sheep for fur purposes gives them twice or thrice the profit that they could derive from wool and mutton only. As the lambs are killed the first few days after birth, the mother ewes are permitted to lamb twice yearly and as the skins bring anywhere from \$4 to \$10 each, it is easy to calculate the breeding value of an Arabi buck. For about thirty days after the lamb has been killed the mother ewes are milked and a delicious cheese is produced, known as "brinza," which brings from 20 to 30 cents a pound, and this alone pays the expenses incidental to the breeding of the sheep, where labor is as cheap as is the case in Bokhara. The meat of the lambs is also an item worthy of consideration. We have yet to learn in this country that chops from very young lambs are very good indeed to eat, especially when properly broiled and served *en brochette.*

An excellent fur is obtained by crossing a half or three-quarter-bred Karakul ram with the long-wooled sheep known as "Roman-

ovskaja," resembling the black-faced Highland. In the last few years Russia has produced a large quantity of this class of fur, which finds its way to Nishni Novgorod, and there is sold for Persian lamb, with which it compares very favorably. Russians are beginning to realize that the English breeds, as the Lincolnshire, Leicester, Cotswold, and especially the Shropshire, which possess a luster almost

FIG. 3. A GRAY FUR 75 PER CENT MERINO-LONGHAIR AND 25 PER CENT KARAKUL.

equal to the Angora goat, give a fur far superior to anything that Asia can produce. Experiments conducted by such well-known breeders as Goodnight, Albright, and others prove conclusively that we can excel in beauty and luster the imported Persian lambskins that are sold in the United States. The writer's experience is limited to the Lincolns, Shropshires, and Merinos, and those interested may exam-

ine the skins produced on my ranch in northwest Texas. The Karakul-Merino cross possesses sufficient luster to be considered salable and could be sold by farmers for $2 or $3 a skin, which is not a bad price for a three-day-old lamb, especially when one considers that

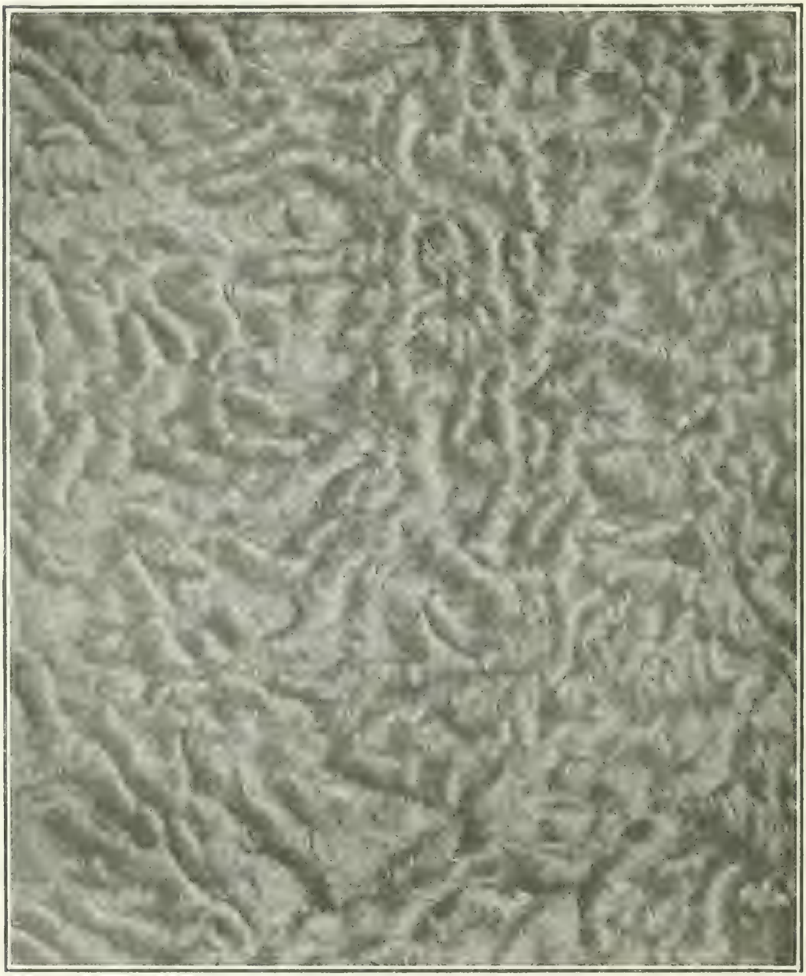

FIG. 4. 75 PER CENT KARAKUL AND 25 PER CENT MERINO-LONGHAIR.

thousands of them are knocked in the head annually on the big sheep ranches, on account of scant pasture, and the dam producing twins and not having sufficient milk. A three-quarter-bred Merino ought to bring a much better price, and I have a three-quarter-bred

Karakuld-Shropshire skin which has been priced at $10. The reason why the Shropshire produces a much prettier skin than the Merino is in my opinion due to the fact that the Shropshire stands between the tight-wool and the long-wool sheep. There is, however, no comparison between a half-bred Karakul-Lincolnshire and a three-quarter-bred Karakuld-Shropshire, and if we wish to excel in luster the best of so-called Persian lamb-skins we must confine ourselves entirely to

FIG. 5. 50 PER CENT KARAKUL AND 50 PER CENT SHROPSHIRE.
This is a magnificent fur, but inferior by far to half-breed Karakul-Lincolnshire.

the long-wool sheep. In my opinion the Lincolns produce the best fur, although the difference in luster between the young Lincoln and Cotswold lamb is hardly sufficiently perceptible to entitle one to a positive statement. It is, however, the opinion of some of the men connected with the U. S. Department of Agriculture, which is now seriously considering the advisability of conducting its own experi-

ments, and for which purpose I have agreed to furnish them with some of my full-blood Arabi rams, that the Leicester and Shropshire will give more luster than any of the other long-wool sheep; but this remains to be determined. I do not believe that we can produce Afghan fur in this country, as it requires a hairy sheep, closely resembling the Mexican goat, which is indigenous to northwestern Turkestan and Afghanistan. It has been suggested to me by the Bureau of Animal Industry that the Barbadoes sheep may furnish us the missing link, and after seeing them I have become convinced that this

FIG. 6. A MAGNIFICENT FUR SUPERIOR TO ASTRAKHAN; 50 PER CENT KARAKUL, 25 PER CENT COTSWOLD, AND 25 PER CENT BLACK-FACED HIGHLAND.

class of sheep will produce a dark brown fur, which may or may not be superior to the Afghan. As the Barbadoes sheep is brown instead of white, which is the color of the Afghan sheep, I doubt very much if we can produce a black offspring.

When a Karakule ram is crossed with any white sheep the offspring is black. A half-breed Karakul generally gives us also a black skin, although this is not always the case, and often the fur is dark gray, resembling a black silver fox. A quarter-bred Karakul, long-wooled,

is gray, producing what is known as Krimmer fur, its price depending entirely upon the amount of luster it possesses; but it is safe to say that the average skin produced by crossing the half-breed Karakul-Lincoln bucks with any of our long-wool sheep will bring \$5. This, however, is not the only advantage gained. By injecting 25 per cent of Arabi into any of our native sheep we unquestionably

FIG. 7. AFGHAN FUR; 50 PER CENT KARAKUL AND 50 PER CENT COMMON AFGHAN.

produce a heavier sheep with a far superior quality of mutton, and one that is a great deal hardier. This has been amply demonstrated by a number of breeders who have crossed the Merino with a Persian Broadtail, of which there are several hundred in the United States, and the best of which contain from 25 to 50 per cent of Karakul blood. In one instance Persian Broadtail bucks, that should properly be

called half-breed Karakul-Shropshires, were sold to a breeder in New Mexico who crossed them again with Shropshires and sold some of the male offspring to W. W. Burch, owner of the American Sheep Breeders' Magazine, who has a splendid sheep farm in northern Michigan. He crossed these bucks, which could not possibly be considered more than quarter-bred Karakuls, with Delaney Merinos and with Lincoln Delaneys, and this is what he has to say:

FIG. 8. YEARLING FULL BLOOD KARAKUL EWE.

A year ago last fall we bred a Broadtail ram to Delaneys and Lincoln Delaneys. The lambs were a marvel both in size and constitution. They grew rapidly, and in August some of them were larger than their mothers, and went through the most severe drought we have experienced in years, and while the other lambs fell off rapidly in flesh those containing Broadtail blood not only held their own but gained right through the dry season, which lasted for about two months. There was absolutely no grass, and the sheep were obliged to

browse, getting what they could in a burnt-over and cut-over timber country. They seemed to defy cold weather and snow, always preferring to stay out in the storms and lie around in the snow. The mutton proved to be wonderfully sweet, and the finest I have ever eaten. I am satisfied that the fat-tailed sheep will play a very important rôle in our sheep husbandry, and if you can get your Karakul crosses introduced it strikes me that the sheepmen will find not only great profit in wool and mutton, but in fur as well.

The introduction of the Karakul sheep into the United States presents many difficulties, chiefly due to the fact that the fanatical

FIG. 9. FULL BLOOD KARAKUL BUCKS; LOWDEN ON RIGHT BELONGS TO THE LARGE CLASS. FASSIT ON LEFT BELONGS TO INTERMEDIATE TYPE.

Bokharans resent the exportations of the full-blood Arabi, and few of them have ever been taken out of their country. Most all broad-tails that are taken out of Bokhara are sold to foreigners as full-blood Karakuls, when in fact they do not contain more than 50 or 75 per cent of Karakul blood, and belong to a type known as Shirazi, Doozboy, and Zigai, and whilst the Russians have attained wonderful success by crossing this class with their native sheep they do not

begin to give the results obtained from the full-blood Arabis. It would be interesting indeed to ascertain what class of common sheep were used in the production of these three types of broadtails, but there is no history, and one can only surmise they belong to the long-wool family, although in some instances the soft underwool occasionally seen would lead one to believe that the tight-wool family may have contributed its share. If Persia, Afghanistan, northwestern and southwestern Russia are having such wonderful success with the Shirazi, Doozboy, and Zigai, why should we not be able to produce a far superior American broadtail, especially when one takes into consideration the fact that no Asiatic long-hair of the non-broadtail variety possesses the luster of our Lincolns and Cotswolds? As Bokhara is considered as an infected country, chiefly on account of surra, it is very difficult to obtain permission from the Department of Agriculture to import Karakuls into the United States, and if one does succeed they are kept in quarantine for months, which is very expensive. If the writer succeeded in bringing the first flock to this country it is all due to the kindness of ex-President Roosevelt, whose personal letter accomplished wonders in Asia. A ruinous sum, amounting to thousands, was spent to bring the first fifteen head to the United States.

ECONOMIC IMPORTANCE OF LIVE STOCK PRODUCTION

HERBERT W. MUMFORD

University oj Illinois, Champaign, Illinois

Sufficient publicity has not been given to the magnitude and importance of live stock production in the United States. One needs only to familiarize himself with the facts with reference to the part this industry plays in the world's commerce, its rational place in the economy of the farm, and its importance as an economic fact in the maintenance of an enticing, permanently profitable agriculture, to become an enthusiast as to its future possibilities. According to the Federal Census of 1900, the capital invested in live stock in the United States is greater than in any other class of property except farm lands.

Class of Property	Value in U. S.* 1900
Farm land with improvements	$16,674,690,247
Live stock	3,078,050,041
Implements and machinery‡	761,261,550
Food and kindred products‡	1,750,811,817
Textiles‡	1,081,961,248
Iron and steel, and their products‡	983,821,918
Lumber and its manufactures‡	547,227,860
Paper and printing‡	419,798,101

*From Statistical Abstract of the U. S., 1908, pp. 124, 178.
‡Value of annual product.

WORLD SUPPLY OF LIVE STOCK

Statistics[1] of the world supply of live stock are incomplete; large areas of Africa are unrepresented; the number of animals in China, Persia, Afghanistan, Korea, Bolivia, Ecuador, Salvador, and several less important countries is unknown; for Brazil the number of cattle alone is estimated; in general, statistics of cattle, horses, sheep, and swine are much more complete than those of other animals, as statements for the world. In some countries the latest available data relate to numbers ten years ago. Keeping in view these deficiencies in data, estimates of the approximate number of live stock in the world, so far as information is available, are of interest.

Sheep seem to be the most numerous of the large animals of the world, with a total of about 580,000,000 head. Australia ranks first, with about 88,000,000; Argentina second with 67,000,000; United States third, with about 57,000,000; European Russia and Asiatic Turkey each have approximately 45,000,000; Great Britain with 27,000,000 in 1908 has more sheep in proportion to its area than any other important nation.

The number of cattle enumerated or estimated, about 430,000,000, although smaller than that of sheep, is much more important, owing to their larger size. In total number of cattle, British India ranks first, with about 91,000,000 (including buffaloes and buffalo calves); the United States ranks second, with about 70,000,000; Russia third, with about 36,000,000; Argentina and Brazil each have about 30,000,000; Germany about 20,000,000; Austria-Hungary 18,000,000 (in 1900), France 14,000,000, and the United Kingdom 12,000,000. The proportion of the total number of cattle which is beef cattle, work cattle, or milch cows has not been estimated.

The United States is preeminent as a swine-producing nation, being credited with approximately 50,000,000 head out of a world

[1]From the Crop Reporter, 1910.

supply of less than 150,000,000; Germany ranks second, with about 22,000,000; European Russia has about 11,000,000; France, 7,000,000; Austria had 5,000,000 in 1900, and Hungary 7,000,000 in 1895. No other country is credited with as many as 5,000,000.

Horses aggregate about 95,000,000; European Russia and the United States have almost an equal number, between 20,000,000 and 25,000,000 head; Argentina has about 8,000,000; Asiatic Russia is credited with about 7,000,000; Germany 4,000,000; France 3,000,000;

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the United Kingdom 2,000,000; Austria and Hungary each had about 2,000,000 in 1900 and 1895, respectively.

Of the 7,500,000 mules that are estimated in the world, more than half are in the United States; no other country is credited with 1,000,000; Spain comes nearest, with about 810,000 in 1907.

These numbers aggregate about 1,260,000,000, in the entire world, while the number of people in the world is estimated at about 1,600,000,000; or about 80 per cent as many domestic animals as people in the world.

There are several ways of making comparisons of the live stock statistics in various countries. It is more or less true that it is quite impossible to make any comparison that would be conclusive. It is interesting, however, to make comparisons from different points of view.

OXFORD NIAGARA 41ST, VOL. 51, P. 1027

Live stock per capita.

Country	Date	Horses	Cattle	Sheep	Swine
The world	....	0.06	0.27	0.36	0.09
Germany	1810	.08	25	1.22	[illegible]
	1903	.08	.36	.13	[illegible]
France	1852	.10	.16	.93	.14
	1908	.09	.19	.44	.18
Denmark	1881	.17	.74	.78	.27
	1903	.19	.73	.35	.57
Holland	1850	.08	.36	.25	.07
	1897	.06	.32	.18	[illegible]
Italy	1852	.08	.16	.29	.08
	1890	.07	.17	.23	.06
United States	1867	.14	.51	1.02	.64
	1909	.23	.81	.64	.62
Illinois	1901	.23	.58	.20	1.02
	1909	0	.59	.14	.80

These statistics do not indicate that as population becomes more dense there is a necessary decrease in live stock.

There is a sense in which it is true that the live stock per capita decreases. It is in the early history of a country when the population is small and extensive systems of live stock production largely constitute the agriculture of the country. In such instances population frequently increased more rapidly than live stock. When, however, the conditions demand the establishment of intensive forms of agriculture it appears as in Germany, France, Denmark, Holland, Italy, and the British Isles, that there is a tendency, with but few exceptions, for live stock per capita to increase rather than decrease.

*Live stock and population per square mile.**

Country	Date of Census	Population	Total Live Stock	Horses	Cattle	Sheep	Swine
Belgium......	1907	643.4	279.8	21.5	157.4		100.9
Holland......	1907	454.0					
British Isles	April 1901 Live stock 1908	345.8	404.0	17.7	96.3	256.7	33.3
Italy.......	1908	306.7					
Germany...	Dec. 1905 Live stock Dec. 1907	290.4	262.0	20.7	99.4	36.7	105.2
France........	1906	189.5	201.6	15.2	68.1	84.3	34.0
Denmark....	1906	167.0	298.7	31.1	118.0	56.2	93.4
United States....	1900 Live stock 1908	25.6	67.8	6.7	23.9	18.4	18.8

*Mules and goats not included because relatively unimportant in most countries.

From this table it appears that there is ample opportunity in the United States to develop a greater animal husbandry. It is true that in most of the countries cited it has been possible to maintain an important live stock industry only because it has been possible to purchase cheap feeds from the United States and elsewhere.

Live stock production must have been found profitable else it would have long since been discontinued. Would it not be well for the farmers of the United States to realize fully that it is not good economic policy to permit their animal foodstuffs to be exported to increase the profits of the farmers and fertilize the farms of these older countries. If favorable conditions for live stock production in the United States could be maintained, every pound of feed produced here that is suitable for live stock production should be converted into live stock, and if economic conditions are not such as to

encourage a more extensive production of live stock on the farms of the United States, it should be the business of the federal government to see that conditions are favorable.

The live stock producers of the United States should be given the most favorable opportunity indefinitely to supply the growing demand in this country for animal products. This will most certainly mean that raw materials suitable for live stock, produced more cheaply

SHORTHORN HERD BULL CORNELIUS 304322.

in other countries than in the United States, should be available to the live stock farmers of the United States at the lowest possible cost, and that they should not be obliged to compete in our markets with finished animal products. Such competition will discourage live stock production, it will render grain farming less profitable, because after all is said, live stock production is the principal outlet of our corn and hay crops. Should live stock production cease to be profitable, the margin of profit in grain growing would be so greatly

reduced that farmers of the United States could not produce grain at a profit and at the same time maintain the fertility of their lands. Sooner or later the fact will be recognized that for many years in this country it was possible to buy agricultural products at a price which was but little above the cost of the labor involved in their production.

When it is known that in the ten years, 1901-1910, the population of the United States has increased 20.52 per cent, while live stock has increased only 10.27 per cent, it is clearly evident that, if it is good policy to develop in this country an important animal husbandry, it is time the government should turn its attention to fostering the industry. With a rapidly increasing population, certain forms of animal production will naturally be supplanted by others, but these new conditions which are being imposed on the live stock producer as a result of increased population have thus far but increased his difficulties.

The subject of the economic importance of live stock production is capable of more expansion than the limits of this article will permit. In closing, however, attention should be called to the fact that in the future more attention will be directed to the relation of live stock production to the economic operation of the farm, with especial reference to the better distribution of labor, the profitable utilization of the residues or by-products of grains grown and the fertilizing value of farm manure.

A NEW METHOD OF HANDLING POLLEN

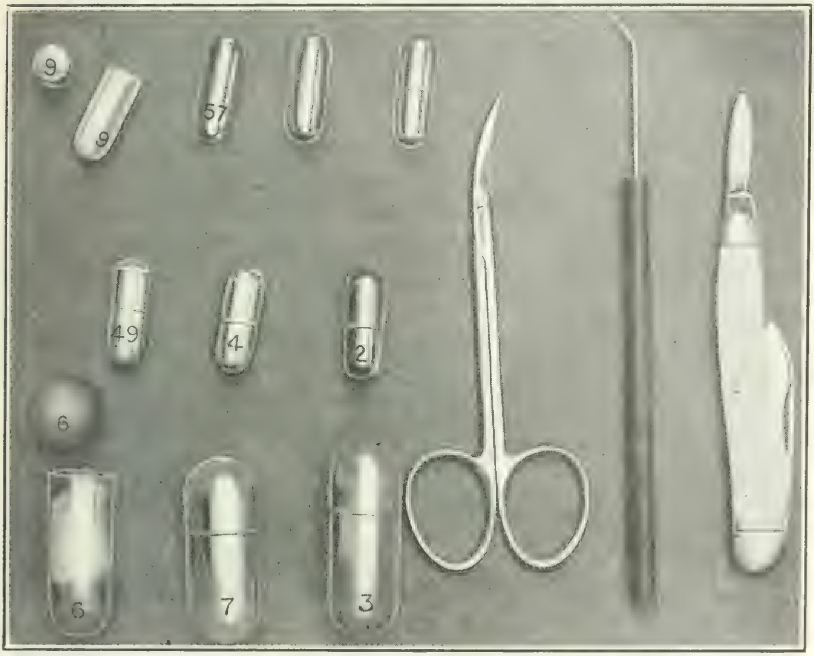
STEPHEN N. GREEN

Ohio Agricultural Experiment Station, Wooster, Ohio

In the spring of 1908, having large numbers of apple, peach, plum and other blossoms to cross and self-pollinate, I was greatly hindered and suffered many losses by the failure to have sufficient pollen on hand at the critical period. The usual method of collecting a fresh supply at each operation was very slow and clumsy. After trying every possible way of collecting and preserving pollen I accidentally found a very simple method, which during three seasons has proven almost ideal.

Empty quinine capsules seem to meet the requirements under almost all circumstances for gathering and storing pollen and they are

convenient to use. These capsules can be obtained at all drug stores at a very slight cost. In most cases the smaller sizes will do. Anthers of the desired female parent are selected as near the bursting point as possible, and scarped or cut into a capsule. The capsule can then be lettered or numbered with india ink or a small slip of paper inserted with note as a record. These capsules can be thrown loosely into a small box or arranged to suit personal taste. In a few hours the anthers in the capsule will burst and a shake will scatter



CAPSULES AND TOOLS USED IN THE PROCESS.

the pollen around, which will adhere uniformly over the gelatin walls inside the capsule, where it can be transferred to stigma with the usual brush or thin-bladed knife. I have found a knife the better tool, as an abundance of pollen can be gathered on its point for transference and it is instantly cleaned. Pollen can thus be very quickly applied to larger pistilled flowers, such as peach, plum, etc.

Pollen in these capsules is available at a moment's notice regardless of outside conditions. A large supply is on hand and in compact shape. A capsule once filled will often last the entire season. It is

surprising the length of time pollen will retain its vitality when so enclosed. These capsules are small and light and can be mailed without trouble. Thus the plant breeder can extend his field of operation by using pollen gathered, for instance, in California and mailed across the continent.

Pollen from almost every flower with which I have worked can be stored and successfully used from these capsules, with the exception perhaps of some of the Cucurbitaceæ. Some pollen from this family seems to be so very moist and sticky that it does not readily separate from the anthers when they are cut before bursting and it does not adhere satisfactorily to the capsule walls.

A NEW METHOD OF CORN POLLINATION

H. F. ROBERTS

Kansas Agricultural College, Manhattan, Kansas

In the breeding of corn, some difficulties are encountered in the technique of pollination, in respect to the prevention of contamination of the silks by foreign pollen, carried on the hands or instruments of the operator, as he goes from plant to plant engaged in the work of artificial pollination. To obviate these difficulties the following method has been devised by the writer, and has been used with success this season at the Kansas Experiment Station. The simplicity of the method and its complete effectiveness seem to justify a description.

The tassel is covered while still immature, and before the anthers have protruded, with a ten-pound manila paper sack such as is commonly used in grocery stores. The mouth of this sack is securely gathered around the stalk beneath the tassel and pinned. For this purpose we find a rather stout long pin sold loose in quarter-pound boxes under the trade name of "Celebrate," size MC, to be the most satisfactory. Ordinary pins are too small and light. The ear is likewise covered with a similar sack, which is drawn tightly over the top of the ear, folded around the stalk on the opposite side and the folds pinned. The sacking of the ear *must be done before the silks have begun in the least to protrude from the husks.* Otherwise pollination of the protruding silks from vagrant pollen is almost certain to occur.

When the silks have grown to a length of five or six inches within the sack, the ear is usually in the best condition for pollination, since

by that time most of the silks have grown out. Inasmuch as the tip of the ear is its youngest portion, the ovaries (grains) are progressively older from tip to base. The first silks to appear, therefore, are

FIG. 1a. MANNER OF SACKING TASSELS AND EARS.

those from the basal kernels, and so on progressively outward, the tip silks being the last to develop. In natural wind pollination of corn, the pollen is blowing about the field for a period of a week or

ten days, during which time the drifting pollen falls on the successive silks as they appear. In artificial pollination, if but a single application of the pollen is made, naturally only those silks (stigmas) will be pollinated which happen to be developed and receptive at the

FIG. 1b. MANNER OF SACKING TASSELS AND EARS.

time. The consequence is seen in a "nubbin" ear. For this reason, the same ear is usually gone over by the pollinator two or three times, in order to secure the successful pollination of the greatest possible number of stigmas.

In the method devised by the writer, it is believed that a greater number of silks can be reached in one pollination, and that the danger of contamination from foreign pollen is practically eliminated.

The pollen is applied to the silks by means of a common insect powder "gun" or spring blower. The blower best adapted to the purpose and which has been used by the writer is the sort known as "Quick Loader," manufactured by the American Can Co. This blower, unlike most others of the sort, which are filled through a hole in top or bottom, comes apart in halves, making it possible both to load quickly and to get at the interior easily for cleaning out,—an absolute necessity in corn-pollination work.

The blower is filled with anthers and pollen from the sack taken from the tassel, the latter being bent over and rapped sharply to secure the shaking off of the loose anthers and pollen.

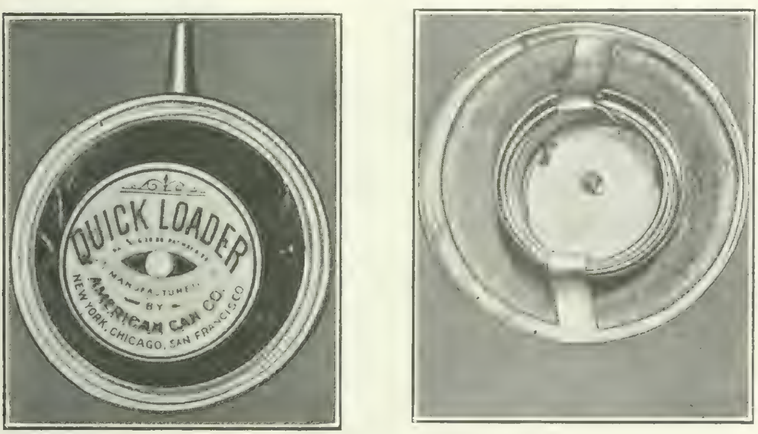


FIG. 2. POWDER GUN USED FOR APPLYING POLLEN.

In the sack the pollen is of course mixed with the mass of empty anthers from which it has been shed. No especial care, however, need be taken to get the pollen separated from the anthers. By having the nose of the blower cut down to a length of half an inch, any anthers which may chance to clog the nozzle can easily be pushed out with a pin. As a matter of fact, for the most part the blast expels pollen and anthers together without difficulty. In cutting down the blower nozzle, which any tinsmith can do, the mouth of the nozzle should be drawn down to the size of the original aperture of the nozzle. Otherwise the opening will be too large, and the air pressure insufficient.

This device has a compression spring attached to its upper half, and a lacquered or varnished cloth tissue allows for the compression of the metal disk above. This upper half of the blower is treated by boiling in paraffin until bubbles cease to come up from the fabric. By this treatment the paraffin, instead of merely coating the surface of the cloth, goes thoroughly into the fiber of the threads. The

FIG. 3. METHOD OF POLLINATING.

blower can now be left in 95 per cent alcohol for the purpose of killing the pollen grains which stick to the sides and the cloth top after use. The blowers were first used without being treated with paraffin, but it was found that the alcohol gradually dissolved the varnish on the outside of the cover, rendering it sticky and disagreeable to handle. Finally, no doubt, the dissolving of the varnish, which gives

an air-tight surface to the cloth, would render the blower less effective, by letting the air through the fabric during compression.

Boiling in paraffin not only seals the cloth more effectively, but also completely protects the varnish from the alcohol, even after an immersion of fifteen or twenty minutes. It is absolutely necessary to adopt some method of killing the pollen grains left after one pollination before proceeding to the next plant. By the use of the hands in pollination, as is frequently the practice, dipping the hand into the mass of pollen and sowing it over the silks with the fingers, it is not only difficult to reach all of the exposed silks, but it is impossible to sterilize the hands afterward with certainty. Simple washing of the hands in alcohol is insufficient to insure the killing of all the pollen grains that may adhere to them.

Pollination by the use of a camel's-hair brush is slow and tedious, it is difficult to reach all of the silks rapidly and satisfactorily, and the surfaces of the silks have to be continually touched. Sterilization of the brush is of course possible by leaving it long enough in alcohol, but the other objections are sufficient to condemn the method. Pollination by simply shaking or pouring the pollen from the sack upon the silks is wasteful, the pollen cannot be directed at will, and it is impossible to reach all of the silks with certainty.

By the use of the insect gun as a means of artificial pollination, complete sterizilation is possible after each operation. In our practice one pair of workers uses three blowers, one being in operation, another, which has been sterilized, being exposed to dry, and a third, the one which has last been used, lying submerged in the alcohol vessel. This gives each blower about fifteen minutes to lie in the alcohol—a time which we find to be more than amply sufficient to completely kill every pollen grain that may lurk in any crevice or in the nozzle or which may adhere to the cloth of the lid.

Aside from the ease with which sterilization can be effected, the blower method is decidedly superior to any other method known to the writer of artificially pollinating corn, in that the pollen is much more economically and effectively used. The blast, with its stream of pollen, can be directed at will into all parts of the mass of the silks, and they can be pollinated thoroughly from base to tip without being touched by the hands, with the consequent danger of injury to their delicate cells.

In our experiments two operators engage together in the work of pollination. One removes the tassel sack, empties the pollen into the blower, and then holds the sack under the mass to catch the waste

pollen that falls during the operation of pollinating. The second operator does the work of pollinating, but is careful not to handle the sack of pollen or to use his hands in any way that would endanger their becoming dusted with pollen. Immediately after pollination, the remaining contents of the blower are emptied back into the tassel sack, the latter is again fastened over the tassel, and the ear is sacked and tagged. The blower is then left in the vessel of alcohol, and the one which was last taken from the alcohol and left to dry is used for the next operation. Working in this manner two men can pollinate eighteen plants an hour with practically no risk whatever of carrying pollen on the hands and of contaminating the successive crosses. It should be stated that the danger from flying pollen is eliminated by detasselling all of the stalks not sacked, before the work of artificial pollination is begun.

THE GENETICS CONFERENCE AT PARIS

What promises to be the most important meeting ever held on Heredity is to take place at Paris, September 18–23. Many of the leading plant and animal breeders and students of evolution in Europe have signified their intention of being present. It is desirable that Americans make a creditable showing at this Congress. Membership fee of 25 francs, or $5, entitles to participation in the meetings and excursions, and to a copy of the proceedings. Those not expecting to attend can receive the proceedings for 15 francs *if sent in advance of the meeting.* Later the price will probably be raised.

Any who desire to take part in the Congress or to receive the published proceedings should send at once the 25 francs or 15 francs, as the case may be, to the Secretary of the QUATRIEME CONFERENCE INTERNATIONALE DE GENETIQUE, M. PHILLIPE DE VILMORIN, 66 RUE BOISSIERE, PARIS, FRANCE.

It is probable that many articles in the published proceedings will be in English. The volume is likely to be much appreciated by students of heredity.

EDITORIALS

THE SECOND VOLUME OF THE MAGAZINE

With the beginning of the second volume of the *American Breeders Magazine* some of the plans which were formulated during the last year are being put into effect and the *Magazine* promises to be much better in 1911 than it was in 1910. The substance, dignity, and tone of the *Magazine* are mainly the product of those who contribute to the annual meeting or directly to the *Magazine*. The formative period of the *Magazine* is not fully past nor is it even desirable that it should for some time assume the fixed individuality peculiar to older periodicals. The endeavor will be to cast the contents of the *Magazine* more along popular lines than heretofore, leaving the scientific and technical contributions mostly to go into the Annual Report.

Under the new plan the bound annual report of the Association will be mailed early in the year. This change will result in the *Magazine* being made up of new matter furnished by the membership after the Annual Report is issued, and necessitated calling upon members for contributions especially prepared for the *Magazine*. This call has been met with a splendid response and the four or more numbers of the *Magazine* for the ensuing year promise to be of unusual interest and value. Through this new arrangement of publishing different matter in the *Magazine* and in the Annual Report, the total amount of original matter placed before the members year by year is largely increased. The *Magazine* and the Annual Report will thus supplement each other and each will possess a peculiar value of its own.

The *American Breeders Magazine* has demonstrated that a genetics magazine has a place among the periodicals of the day and has fully justified the purpose of its existence. While its field is broad and is touched in part by numerous periodicals, it has a major field which encroaches upon the main domain of no one of them. The *Magazine* has been received very favorably on all sides. It has helped to place before the public the work of the American Breeders Association and in this way has been instrumental in a substantial increase in membership during the last year. The reviewers have given it credit for

A GENETICS MAGAZINE

maintaining a high standard, both of subject matter and of literary and typographical form. With its growing constituency both of contributors and of supporting members the standard will be raised and maintained at a higher level than during the last year.

THE NEW EDITORIAL STAFF

The shifting of a portion of the editorial responsibility to Messrs. Webber, Mumford, and Davenport, secretaries, respectively, of the Plant Section, the Animal Section and the Eugenics Section, together with the election of Mr. Knorr to the position of editorial secretary, materially strengthens the editorial work on the publications of the Association. All members are especially requested to send notes and news of vital interest in connection with problems of heredity and breeding. Persons who have in mind papers for the *Magazine* or addresses for the annual meeting should communicate early with the respective committees, section secretaries, or the secretary of the Association.

FRANCIS GALTON

News comes of the death of Francis Galton. He had reached an advanced age—eighty nine—retaining his intellectual vigor and activity to the last. Through his work he has not only enriched science, but has so amplified several of its departments as to leave a lasting impress.

His creation of the new science of eugenics, for which he not only supplied the name, but outlined in large part the methods of research, is alone sufficient to earn for him a place by the side of Darwin and other masters immortal in science. Later generations will be in much better position to comprehend the full meaning, the importance and vastness of the thought of pressing science into service in the betterment of human heredity.

It is gratifying to know that the American Breeders Association, the first body of scientists to give recognition officially to the new science of eugenics and the first to set to work a large number of scientists for specific research work in eugenics, should four years ago have done honor to Mr. Galton by electing him as honorary life member.

By a strange fatality, Mr. Galton leaves no descendants and the line of descent, which on his maternal side traces to Erasmus Darwin, the half cousin of Charles Darwin, is extinguished with his death. A portrait of Dr. Galton and a brief biographic sketch were published in no. 2, vol. 1, of the *American Breeders Magazine*.

IMPERIALISM IN DEMOCRACIES

The bulk of the power of a republic rests with the people, who can arise en masse and sweep aside the most powerful organization managed by the mightiest of leaders. The people conserve and accumulate their own dearly won power, which they guard with jealous care as against that imperialism which claims the divine right of kings. The people install leaders, surround them with lieutenants and support them with votes. They build up parties and install governmental machinery. They temporarily invest very large power in their rulers, and they hold them to account. They do not allow their elected officers to claim the right to remain in office except by the will of the people.

Republics grow into colossal communities, intricate beyond measure, yet with the leading forces so organized as to serve each and all the people. New ideas, which are ever springing from man's mind, are cast into the ever evolving social organism, and are soon assimilated. Evolution in a republic, as in plant and animal organisms, in part comes by sudden mutations, and each mutation is assimilated and evolved into symmetrical forms by almost imperceptible steps day by day and year by year. Some profound changes which have suddenly come in mechanical lines are printing, steam, telegraphy, electric power, telephony, aerographs, and flying; each in its turn having seized the public mind, which has absorbed, digested, and adapted it to the multifarious uses of which it is capable.

Human heredity, like heredity in plants and in lower animals, changes by means of occasional wide mutating leaps followed by slow evolutionary adaptation a small step at a time. Thus most men are average in ability, and one in ten thousand is above ordinary ability and one in a million is a genius. When a genius and a new idea are in combination a general mutating movement occurs.

Situations arise in which men secure wonderful opportunities and seize almost imperialistic power. Thus Washington dictated nationalism, Lincoln dictated emancipation, and Roosevelt dictated a fight on greed. In political life men are followed with a devotion which is almost frenzy. And temporarily the leader has the power to direct the affairs of state. Some men use this imperialistic power to the advantage of all people. Occasionally men who are unduly avaricious for power or money greatly abuse the public confidence, just as crowned kings often rule solely for their own benefit and not to benefit the ruled.

In the world of art a genius becomes the center of a new school of expression, whether it be in oil, in sculpture, in music, or in architecture. His imperialism is idealistic rather than material and political. The great mind in science, invention, art, oratory or literature creates a great mutation in the affairs of men and thus an upturn in civilization arises from the leadership of a single person. True, the times must be ripe, just as the great oration can only spring from the able speaker under the fortuitous combination of the man and the occasion.

MUTATIONS—INDIVIDUAL AND GENETICAL

Mutation seems to be the evolutionary milestone of all organisms. In heredity the mutation has two elements. There must be an individual of exceptional or peculiar development; and it must have the power to project into its progeny its own exceptional values. An imperialistic thought which brings to man a new conception of large import has in it the first of the two elements named. And as it goes forth and affects the minds and the material interests of men its values are comparable with those organisms which are true mutations. But human mutations in the heredity sense are exceedingly rare. One can point to but few geniuses who begot geniuses. Among all kinds of organisms there is one rare individual in thousands or in tens of thousands. But of these rare individuals only one in many has the second element,—that of being able to project its excellence strongly into its progeny.

The imperialism of the genuis or of the mutating plant or animal is indeed marvelous. These steps toward perfection are inspirational. They demonstrate that heredity is as substantial an entity as metal, mineral, or soil They prove the power of the inner spirit of things. They lead toward the conception of the unity of all energy.

ACKNOWLEDGMENTS OF COURTESIES

The American Breeders Association is under lasting obligation to numerous herdbook associations, horticultural societies and other organizations, also to many private business firms, for the cordial spirit of coöperation with which they have met the American Breeders Association in its efforts to enlarge its membership. Special appreciation is hereby expressed for the courtesies extended by the secretaries of the following organizations:

Holstein-Friesian Association, Brattleboro, Vt.

American Hampshire Sheep Association, Cold Water, Mich.

American Cotswold Registry Association, Waukesha, Wis.

American Hackney Horse Society, New York, N. Y.

American Berkshire Association, Springfield, Ill.

American Shropshire Registry Association, Lafayette, Ind.

American Carnation Society, Indianapolis, Ind.

American Leicester Breeders Association, Cameron, Ill.

The R. M. Kellogg Co., breeders of strawberries, Three Rivers, Mich.

West Virginia State Horticultural Society, Morgantown, W. Va.

Indiana Horticultural Society, Lafayette, Ind.

Much good will result from these cordial relations, and it will immensely facilitate the propaganda of the American Breeders Association for the better understanding of the laws of heredity and their application to practical breeding to the end that large economic results may be achieved. The *American Breeders Magazine* will assist in every way possible the enlargement and the betterment of the work of breed associations, and we are pleased to note that the secretaries of the various associations are beginning to coöperate with the American Breeders Association.

EXTENDING THE ORGANIZATION OF THE AMERICAN BREEDERS ASSOCIATION

Professor Levi Chubbuck, of Denver, Colorado, transmitting the membership fees of eleven new members for 1911, writes that some time in February a number of new and old members of the Association met in Denver for the purpose of organizing a Colorado section of the American Breeders Association. A constitution has been drafted for this affiliating organization and plans have been made to start the branch association with an even hundred members. Much useful and effective work is certain to come from this new organization. The successful launching of this branch organization points the way in which the American Breeders Association can be extended in other states, and has led to plans which will make it possible for existing breeders' associations, of which there are many, to affiliate if they desire, with the national organization.

By extending the genetics propaganda of the American Breeders Association through organization of genetics associations, and placing in the hands of this entire membership the publications of the Association, a tremendous power will be started for progress in science, in agriculture, and in social and economic betterment.

The interest of thousands of persons will be aroused in questions of heredity, in the breeding of plants and animals and in eugenics

The mind of the general public is becoming receptive to the vital facts of heredity in man and is showing evidences of appreciation of the work of the skilful breeder of plants and animals.

ORGANIZATION OF COÖPERATIVE BREEDING

American agriculture is generally on a basis of individual ownership by the family of a small tract of land, such as the members of the family can manage mainly with their own labor. There are occasional large estates and these are scattered throughout all parts of the country, and in some portions of certain states large farms constitute a considerable proportion of the entire area. A few people, who have the European idea, predict that the land will gradually drift into the hands of the wealthy in the form of large estates. But wherever the Caucasian race has settled in new territory without the presence of an inferior race the plan of family farms has been generally adopted and racial progress has there been most rapid. On the other hand, where there has been an inferior race, the large farm estate has been the rule and racial progress has been less rapid. New Zealand, Canada, and the northern United States are examples of countries where the family farm plan prevails and where the most rapid racial progress in the world is taking place. South Africa and the southern United States are examples of countries where the large estate was more generally developed. Many reasons might be cited in favor of the family farm plan as against the large estate in most if not in nearly all parts of the world where the soil is cultivated. It may be a part of the white man's burden to help develop country life in the entire world on the family farm basis.

Nearly all people who know the better side of country life conditions where the family farm prevails regard the production of folks as the principal crop. The trend of the philosophy of our times is to urge people to return to the soil. This does not mean that they should return and be farm laborers on large estates, but that they become owners and managers of farms and farm homes. There are a few lines of farm business which at times seem to drift under the form of organization of the large farm or the large fruit ranch. The invention of large and complicated machinery sometimes seems to lead to the organization of farming under large units with a high degree of division of labor.

But on the whole the individualistic farmer holds his own and pays more per acre for the land for a combined home and business than the owner of money is willing to place in the land as simply a commercial

investment. Certain it is that twenty independent homes on owned farms make for a stronger country life civilization than does one beautiful farm mansion, one manager's house, and twenty laborers' cottages. Besides the better aggregate of home life in the twenty independent homes, they also support better schools, more virile churches, a more excellent social organization; a more highly conserving political status exists and the output of folks is a better trained, more hopeful class of young people, more highly inspired and supplied with a larger aggregate of money with which to start in life for themselves.

For the family farms to compete better in mere commercial production with the plan of the large estate the farmers must learn how to do collectively some of the things which the large estate can best do because of its centralized organization. In other words, that the farmer may retain the vital part of his individualistic status, and own most of the land as family farms he must give up portions of his individualism and merge them into coöperations which he and his fellow-farmers manage collectively.

There is need of laws and a new jurisprudence of coöperation. At present coöperative enterprises must organize, operate, and be closed up, under corporation laws which are not adapted to the form of organizations known as coöperations. These new laws should facilitate the organization of coöperations. They should better provide for the conduct of business by coöperative organizations, and, quite as important, they should provide for reorganization in case of temporary embarrassment, in place of the harsh closing-up processes provided under laws which relate to corporations.

During recent years coöperation has entered into the breeding of domestic animals. This is one of the most significant phases of coöperation. Much of the work of testing individual animals, of securing superior purebred sires, of creating new strains and breeds, and of preserving unmixed the choicest breeding blood as sources of breeding animals with which to grade up the best stock everywhere, can be done far better under coöperative organization than by the individual farmer alone. As in other lines of coöperation, much coöperation in animal breeding will aid in preserving to the farmer the individualistic business of breeding pedigreed animals. But the plans for this coöperative breeding go even further, and have included coöperation by state experiment stations and by the national Department of Agriculture with the farmers. And under this several forms of coöperation in animal breeding have been developed in this country.

Coöperation in breeding up the farm herds of the neighborhood is best exemplified by the cow-testing associations of Denmark and later of Michigan, Wisconsin, Connecticut, and other states. The principal features of this plan are that a group of a'out twenty-five farmers employ a man trained in testing the values of cows. By visiting the farms periodically he determines the amount of milk given for the month and the amount of butter fat produced, thus securing data from which are calculated the annual product of milk and butter for each cow. He also gets a close approximation of the amount of food used by each cow and determines its value. The difference between the cost of food and the value of product determines the rating of the cow, in net dollars of income. As the generations of cows come and go these performance records furnish also a basis for the valuation of each cow as a producer of cows, and also of each bull as a producer of cows—and also of sires. The cowtesting inspectors and intelligent farmers soon learn the significance and value of the recorded figures fashioned into pedigree performance tables. They are led to scrutinize the evidences of the breeding efficiency of bulls offered for sale as sires of other herds. Very rapidly the poor cows are eliminated from the herds; and the blood of the very best sires and dams is rapidly multiplied so that the herds are brought up to a high average of earning efficiency.

COW-TESTING ASSOCIATION

FINANCING THE MAGAZINE FOR WIDER USEFULNESS

For more than a dozen years the Secretary and many other loyal members of the American Breeders' Association have labored diligently and without remuneration, for the upbuilding of the Association and as a result of their expenditure of energy and time, the organization is now well established. It has gained a substantial place in the scientific organizations of the world.

The American Breeders' Association, being a coöperative organization, utilizes for its own purposes all fees paid by members, all moneys given by friends, and all services freely given it by the earnest workers who are putting forward the science of heredity and breeding. The life membership fees of $20 each, which must be invested and only the income from which may be used, now amount to about $3000.

The publications of the Association have maintained a high standard of scientific and practical excellence. The six bound Annual Reports already published, and the seventh, now in press, contain

the most important body of knowledge extant on genetics and practical breeding. The *American Breeders' Magazine*, now in its second year, is taking its place as a periodical of the widest importance. The present issue is an earnest of what can and will be done by this publication as a Genetics magazine, when a large membership supplies the means with which to develop it.

The movement under the leadership of the American Breeders' Association should be rapidly expanded. The important need of the present is publicity, and through it a larger membership. To get a large membership, funds must be made available to employ a Membership Secretary who will devote his entire time to securing members. For this purpose an investment of $5,000 is now needed. A subscription list has been opened and in this issue the appeal is made for subscriptions of $100 each. Fifty men each of whom is able to give $100 are earnestly requested to coöperate with the officers of the Association in assuming the burden of placing the American Breeders' Association in a position from which it will grow into a very large and powerful organization. All are urged to aid in this effort to secure a campaign fund. Old members are still more earnestly urged to secure new members.

COÖPERATION IN ANIMAL BREEDING

We have a class of large general associations of the breeders of pedigreed animals called herdbook associations. These are essentially coöperative organizations and they have done an immense service to American live stock. They have successfully kept the lineage pedigrees of the breed secured from Europe or originated in this country. Yet, they have had some shortcomings. They, for too long, depended exclusively on lineage pedigrees as evidence of breeding efficiency.

Beginning with the work of John Wallace in putting trotting horse pedigrees on a basis of performance records, followed up by the advanced registry scheme of dairy herdbook associations, we are developing a class of herdbook organizations which are gradually paying more attention to inherent efficiency and to performance record additions to all pedigrees. Too long have the leaders in our great live-stock papers, in live-stock chairs of our agricultural colleges, and the orators in the live-stock sales ring adhered to the evidences of excellence which are made up by the prices received in the sales ring and by the prizes secured at the live-stock show. These

ADVANCED REGISTRATION

are excellent evidences, but they too often relate only to the visual individuality of the given animal rather than to its inherent breeding efficiency. The animal phenomenal in individuality, rather than the animal phenomenal in the power to project excellence into his or her progeny, is given the larger consideration. The broader plan of the future will not give less consideration to individual excellence, but it will give far greater prominence to the breeding power as based on the average record of performance of ancestors, of collateral relatives, and especially of progeny. There is need of the most searching scientific, almost cold-blooded, investigation of the present status of pedigree herdbook associations and the philosophy of their methods, and to show how they may more effectively improve the respective breeds. Certainly they will find it advantageous to extend all such coöperative work as may help them build up the average excellence of the respective breeds; that pedigrees, far more than now, may be the compelling evidence which causes all growers to use purebred or first generation hybrid stock.

SIRE-OWNING ASSOCIATION

One class of coöperative breeders' associations is the so-called sire-owning associations. Under this form of organization a number of farmers or breeders form an organization under which they collectively own a group of sires. These sires are kept at places where they can be most conveniently and most advantageously used by the respective members. Members of the association, or employed experts, are chosen to make the wisest possible selection of sires. Records more or less complete are kept of the values and performance of the progeny of each sire under systems which permit of the comparison of the breeding value of the respective sires. Sires which show progeny only medium in value are at once discarded. Sires which beget young of especially high average value are retained as long as they are fit for service. They are rotated among the herds so as to avoid any inbreeding which experience may prove unwise.

Another type of coöperative breeding is found in the so-called circuit breeding scheme. This plan best provides for creating marked new values. It utilizes all the advantages of the three other plans and all here supplement each other. And all lead under the scheme for circuit breeding to the discovery of those rare animals, one in perhaps many thousand, which serve as mutative bases of new families and of new values advanced above any values before available. As outlined in two projects already started, one with milking Shorthorns in Minnesota, the other with Holstein cattle in North Dakota, the

United States Department of Agriculture, the state experiment station and local breeders are organized into a triangular form of coöperative association. The management of the work is vested in a council composed of one member appointed by the Secretary of Agriculture, one appointed by the director of the state experiment station, and one chosen by the farmers who form the coöperative breeding circuit association. The Department of Agriculture and the experiment station each make an annual cash contribution toward paying the salary and expenses of a circuit superintendent, chosen by the council, and possibly provide some expense money to help pay the expenses of securing superior male animals from a distance. The coöperative association is made up of about twenty breeders. Each breeder contracts with the association and with the coöperating institutions that he will enter into the circuit a minimum number of circuit "approved" animals. In case of cattle, he agrees also to breed, care for, feed, and test his animals under the supervision of the circuit superintendent. He agrees that the superintendent, acting under the council, shall divide all animals into three classes. Those which are not considered fit for registration will be classed as "discarded" and are not eligible for use as registered animals. Those which are not chosen for the circuit breeding will be called "registered" and will be accredited to the national herdbook of the breed for registration there, and those which are deemed of greatest value to be used in the circuit breeding will be called "approved," and will, of course, also be registered in the national herdbook. Members will further promise the department and the station that "approved" animals shall be offered for sale only for use within the circuit, while registered animals may be sold to persons ouside the circuit.

Under this plan, with some help from public funds, the circuit can secure the best blood of the breed to be found in the country or even to be found in other countries. By rigid tests and valuations of each animal from birth to maturity the value of the different lines of blood brought into the circuit can be determined. In case strains are found of remarkable value, they can soon be made the basis of stock of the entire circuit. Under plans for not too narrow breeding, this blood can then be kept intact permanently.

A PERPETUAL FOUNT OF NEW BLOOD

In case that anywhere in herd test associations, in sire-owning associations, in the advanced registry work of herdbook associations or in the unattached private herds or in other circuits of the same breed, a phenomenal blood strain is discovered, the circuit can secure this blood and test it within the circuit.

NEWS AND NOTES

MALADJUSTMENTS IN SECOND-GENERATION HYBRIDS

In the South one frequently hears the statement that the first cross between the white and the black races is vigorous and healthy but that the subsequent generations descended from these mulattoes are weakly and highly subject to diesase. While the fact that an opinion is general does not necessarily prove it to be true, there are theoretical reasons for suspecting that the opinion referred to in this case is true. There is also experimental evidence to substantiate it, at least in species other than man.

In the first-generation hybrid all the characters of both races are present, and there is opportunity for the development of a normal organism more or less intermediate between the two parent races. This is especially true for those characters which blend whether they segregate later or not; but for characters in which there is marked dominance we might have a given organ of the body much more like one of the parent races than the other, while another organ of the body might be more like the other parent race, thus giving more or less maladjustment. But in the second and later generations we may get any combination of the original parent characters. This might, and doubtless does, frequently result in some of the organs of the body being strikingly like those of one of the parent races while other organs would be as strikingly like the other parent race.

Where the two races differ markedly in respect to vital organs or vital processes, we may thus have serious maladjustments. We of course do not know the complete Mendelian relations of any entire organism, hence there is very little definite to be said about what the maladjustments would be. We might, however, have in an organism of a second-generation hybrid a heart similar to that of one parent race and lungs similar to those of the other parent race, and these two organs—the heart and the lungs—might not be adapted to work together normally. So we might have differences between any vital organs or vital processes whereby the various parts of the organism are not properly correlated.

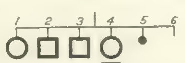
Some very interesting evidence bearing on this point was obtained by Mr. Q. I. Simpson in his hybridization work with European wild

hogs and our domesticated breeds. The first-generation hybrids were exceedingly vigorous, and evidently their various vital organs were well correlated with each other. But in the second generation of these hybrids, as well as in pigs produced by crossing the hybrids with either of the pure races, new Mendelian combinations of characters caused various organs to be poorly adjusted to each other. For instance, some of the pigs had the greedy appetites of domesticated hogs with the small digestive apparatus of the wild hog, and died from over-eating—a thing a domesticated hog seldom does, because he has a digestive apparatus commensurate with this appetite.*

It seems probable from the evidence at hand that Mendelian recombination in the second and later generations of hybrids between distinct races may frequently result in maladjustments that may have serious consequences for the organism.—W. J. SPILLMAN, *Washington, D. C.*

CONVENTIONAL SYMBOLS FOR PEDIGREE TABLES

At a meeting of persons interested in pedigree work among defectives, held at Lincoln, Ill., last spring, supplemented by a meeting held at Skillman on October 14, the following conventional signs in pedigree tables were adopted: □ Square, male. ■ Affected individual, male. ○ Circle, female. ● Affected individual, female. ○┬□ A union of circle and square by a horizontal or oblique line, marriage. Miscarriage or still-birth would be indicated by a small solid dot. All members of a family would be connected by a short vertical line with the same horizontal line. Order of birth would be indicated by a figure placed above this horizontal line.



In case sex is unknown, circle or square is to be omitted. Underscoring a circle or square indicates institutional care. The following letters are employed, to be placed inside the circle or square. If two letters are employed, that representing the more important or primary condition to be inside the circle or square and the remaining letter or letters to be placed outside.

A, alcoholic.
B, blind.
C, criminal.
D, deaf.
Dwf, dwarf.
E, epileptic.
F, feeble-minded.
I, insane.
M, migraine.
N, normal.
S, syphilis.
SX, grave sexual offender.
T, tuberculosis.
W, wanderer, tramp, truant, etc.
b, born.
d, died.
m, married.
d. inf. (inside of circle or square), died in infancy.
illeg., on vertical line means illegitimate child.

A numeral inside the circle or square indicates a number of persons of that sex grouped together to save space or because little is known about them.

d. early is to mean (*a*) in the case of feeble-minded, died before 7 years; (*b*) in the case of epileptic, died before 14 years; (*c*) in the case of insane, died before 25 years.

Wherever epilepsy is present the E is to be placed inside the circle or square, and any other condition or future developments to be placed outside the square.

Institutions working on similar defective families in the same state are to exchange data.

Unclassifiable conditions which are abnormal are to be indicated in the charts by the striated circle or square, and, in tabulating, the condition is to be explained and not to be passed over with the application of a descriptive term.—C. B. DAVENPORT, *Cold Spring Harbor, N. Y.*

SOME CYTOLOGICAL CORRECTIONS

As the members of this Association are all interested in cytology, I desire to call attention to some errors that still pass current as facts in most text-books on cytology and heredity. The first of these that I shall mention is that there is a specific number of chromosomes in the germ cells of organisms.

In his late papers Dr. Wilson states:[1]

> The most conspicuous departure from the relations to which we have become accustomed lies in the fact that different individuals of the same species often possess different numbers of chromosomes, though the number in each individual is constant. An even more surprising fact is that in all of my own material every male individual possesses at least 22 spermatogonial chromosomes, including a pair of unequal idiochromosomes like those of the Pentatomidæ, while in Montgomery's material of *M. terminalis* every male has but 21 spermatogonial chromosomes, one of which is typical odd or "accessory" chromosome (unpaired idiochromosome).

The second error is that the gametes have an equal number of chromosomes. That is, the spermatozoa have one-half the number of

[1] Journal Exp. Zool. VI, p. 147.

the fertilized egg. It is now known that there is dimorphism in spermatozoa in many species of animals. Examples, Orthoptera, Homoptera, and Heteroptera, etc.

The third error is that the chromosomes may be used by the taxonomist in classification. Dr. Stevens states:[2]

> It has become evident in the course of the work that little dependence can be placed on the present classification of the aphids and that a reclassification based on the cytology of the germ cells may be necessary.

Dr. McClung states in speaking of the germ cells of a grasshopper:[3]

> There are thus within the germ cells of these animals certain structures that show specific, generic, and family characters in just as pronounced a manner as do the completed organisms wherein they are formed.

T. H. Montgomery states:[4]

> The conviction almost forces itself upon one that chromosomal relations not only furnish the basis for any understanding of the process called heredity and differentiation, but also bid fair to become the basis of taxonomy.

Dr. Lillie:[5]

> The chromosome group of the species contains the sum total of material transmitted from one generation to another. Each chromosome represents in each stage some property of the entire organism.

Dr. Wilson states:[6]

> In the genus Banasa a much greater numerical difference exists between two species that are otherwise so similar as sometimes to have been confused by systematists, though the examination of a large series has convinced me that they are always distinguishable by structural characters. These species are *B. calva* and *B. dimidiata*, of which the former has typically 26 chromosomes, the latter 16. But the most remarkable case, and the one to which I would direct special attention, is that of the common and widely diffused form *Thyanta custator*, in which two types of chromosome groups exist in a species which competent systematists have not thus far been able to differentiate even into two varieties. Individuals taken at Madison, New Jersey, show in the male 27 chromosomes, in the female 28; while all those from Georgia, South Carolina, Tennessee, and Colorado have in both sexes but 16. No intermediate numbers have thus far been found. This species is a very variable one in respect to shape, size, and color, and all the western forms and many of the southern ones differ noticeably from the New Jersey ones. Nevertheless, Van Duze, the well-known specialist of Pentatomidae, who has kindly examined

[2]Studies on the Germ Cells of Aphids. Carnegie Pub. No. 51.

[3]Cytology and Taxonomy. Kansas Univ. Sci. Bull., Vol. IV, No. VII.

[4]Science, Jan. 5, 1906

[5]Journal Exp. Zool., p. 262.

[6]Differences in the chromosome-groups of closely related species and varieties, and their possible bearing on the "Physiological Species."

the series, states that he is unable to find in the external characters any line of demarcation by which the individuals of the 16-chromosome type can be separated from the others.

For the past three years I have taken great interest in spermatogenesis in insects, having worked upon and photographed the chromosomal complex in Aphidæ, Pentatomidæ, Coreidæ, Lygaeidæ, Acridididæ, Gryllidæ and Chrysomellidæ. I find differences apparently as great in the size, arrangement, and number of chromosomes as I do in external characters of a species.—L. C. BRAGG, *Ft. Collins, Colo.*

TERMS OF THE GALTON BEQUEST

Sir Francis Galton, F.R.S., who died on January 17, aged 89, has left his residuary estate to the University of London for the purpose of encouraging the study of national eugenics. This residuary estate will amount to about £45,000. He left property of the gross value of £115,932, of which the net personalty has been sworn at £113,371.

In a codicil Sir Francis Galton describes the scope of his new foundation in the following terms some technical phrases being omitted:

I devise and bequeath all the residue of my estate and effects, both real and personal, unto the University of London for the establishment and endowment of a professorship at the said university to be known as "The Galton Professorship of Eugenics," with a laboratory or office and library attached thereto. And I declare that the duty of the professor shall be to pursue the study and further the knowledge of national eugenics—that is, of the agencies under social control that may improve or impair the racial faculties of future generations physically and mentally. And for this purpose I desire that the university shall, out of the income of the above endowment, provide the salaries of the professor and of such assistants as the senate may think necessary, and that the professor shall do the following acts and things—namely:

1. Collect materials bearing on eugenics.
2. Discuss such materials and draw conclusions.
3. Form a central office to provide information, under appropriate restrictions, to private individuals and to public authorities concerning the laws of inheritance in man, and to urge the conclusions as to social conduct which follow from such laws.
4. Extend the knowledge of eugenics by all or any of the following means, namely, (*a*) professorial instruction; (*b*) occasional publications; (*c*) occasional public lectures; (*d*) experimental or observational work which may throw light on eugenic problems.

He shall also submit from time to time reports of the work done to the authorities of the said university.

I also declare that the said university shall be at liberty to apply either the capital or income of the said moneys for any of the purposes aforesaid, but it is

my hope that the university will see fit to preserve the capital thereof wholly or almost wholly intact, not encroaching materially upon it for cost of building, fittings, or library. Also that the university will supply the laboratory or office at such place as its senate shall from time to time determine, but preferably in the first instance in proximity to the biometric laboratory. I state these hopes on the chance of their having a moral effect upon the future decisions of the senate of the university, but they are not intended to have any legally binding effect whatever upon the freedom of their action. And I declare that it shall be lawful for the senate of the said university, if they shall think fit so to do, to postpone the election of the first or any subsequent professor of eugenics for a period of not exceeding four years from the date of my death, or from the date of the occurrence of any vacancy in the office as the case may be.

I declare it to be my wish, but I do not impose it as an obligation, that on the appointment of the first professor the post shall be offered to Professor Karl Pearson, and on such conditions as will give him liberty to continue his biometric laboratory now established at University College.

PUBLICATIONS RECEIVED

DOMESTICATED ANIMALS AND PLANTS. A brief treatise upon the origin and development of domesticated races, with special reference to the method of improvement." Dr. Eugene Davenport, dean of the College of Agriculture, director of the Agricultural Experiment Station, Champaign, Ill. 321 pages, illustrated. Ginn & Company.

A text-book on the principles of breeding as applied to our domesticated animals and plants, and written for use in high schools, normal schools and for the general student. This book is an abridged and simplified form of the larger and more technical work "Principles of Breeding" by the same author. It fills the place of a much needed text-book on this subject, especially at this time when many of these institutions are expanding their courses of study by adding agriculture. Most excellent use is made of everyday biological facts and their relation to human affairs is attractively and interestingly presented, and throughout the book there runs a current of wholesome philosophy.

Five pages are devoted to instruction "to the teacher." A summary and list of exercises concludes each chapter. Many references are given for use of the reading student. A glossary of technical and scientific terms in the appendix is very useful in view of the fact that the rapid development of the science of heredity is creating and constantly adding difficult new words expressing new conceptions of heredity phenomena.

The author has succeeded not only in presenting the subject of breeding, and of domesticated plants and animals in pedagogical

form, and bringing it down to high-school grade, but he has succeeded in telling it interestingly, so as to hold the attention of the general reader. Dean Davenport's two books mark the new movement in texts relating to breeding, and ere long texts, laboratory work, demonstration breeding, and the results of research in relation to heredity will have gained for this subject a large place in our schools. Since the study of heredity will be both a "culture" study and a vocational study it will gain a large place in our educational system. Dean Davenport's pioneering work is most valuable, both because of the excellence of his books and because they blaze the trail in this subject.

THE IMPORTANCE AND IMPROVEMENT OF GRAIN SORGHUMS. Carleton R. Ball, agronomist in charge of grain sorghum investigations. Bul. No. 203, Bureau of Plant Industry, U. S. Department of Agriculture.

EUTHENICS AND EUGENICS. Dr. C. B. Davenport, Cold Spring Harbor, N. Y. Reprinted from *The Popular Science Monthly*, January, 1911, pages 16 to 20.

LITTLE TRIPS TO THE HOMES OF GREAT HORSES. Hambletonian 10. Arthur Calton Thomas, Equine Publishing Co., Omaha, Nebraska.

"HEREDITY" OR PARENTAL ENDOWMENT—SOME GENERAL LAWS. Dr. Pauline Myers, Marshalltown, Iowa, 39 pages.

HEREDITY OF SKIN PIGMENT IN MAN. Gertrude C. Davenport and Charles B. Davenport. Reprinted from *The American Naturalist*, Vol. XLIV, November and December, 1910, pages 642 to 731.

DEGENERATION, ALBINISM AND INBREEDING. Charles B. Davenport. Reprinted from *Science*, n. s., Vol. XXVIII, No. 718, pages 454 to 455, October 2, 1908.

CALIFORNIA'S NEW INDUSTRY, GROWING HUMANS. Bulletin of California State Board of Health. Vol. 6, No. 5, illustrated, pages 265 to 369.

CATTLE BREEDERS' ASSOCIATIONS IN DENMARK. Frederick Rasmussen, Bull. 129, Bureau of Animal Industry, U. S. Department of Agriculture. 40 pages.

FORTY-SIXTH ANNUAL REPORT OF THE QUEENSLAND ACCLIMATISATION SOCIETY, Brisbane, Australia. Report covers period August 1, 1908, to March 31, 1909. 34 pages. Mr. Nicol Robinson, honorary secretary.

A BIOMETRICAL STUDY OF EGG PRODUCTION IN THE DOMESTIC FOWL. Raymond Pearl and Frank M. Surface. Bul. 110, Part II, Bureau of Animal Industry, U. S. Department of Agriculture. Pp. 81 to 170.

SEEDS AND PLANTS IMPORTED DURING THE PERIOD FROM OCTOBER 1 TO DECEMBER 31, 1909. David Fairchild, Agricultural Explorer in Charge. Bureau of Plant Industry, U. S. Department of Agriculture, Bul. 205. 1911. 54 pages.

ASSOCIATION MATTERS

PRINTS OF PORTRAITS FOR FRAMING

There have recently come to the office of the Association a number of orders for single copies of the *Magazine* from persons who desire to frame the portraits of the noted men whose biographies have been published. To meet this demand a limited number of these portraits have been printed on a fine quality of enameled translucent India sepia paper in sepia tone. The effect is very pleasing. The size of these portraits is 6 by 9 inches and they may be mounted, panel-fashion, in sets of four or more, so as to be suitable for hanging in class-rooms or dens. While the supply lasts, copies may be had from the Secretary's office at exact cost price, 10 cents each or $1.20 for the entire set of 12. These prices include postage. The following are the names of the subjects of the twelve portraits:

Charles Robert Darwin, Gregor Johann Mendel, Amos Cruikshank, Francis Galton, Pierre Louis Francois Leveque de Vilmorin, John H. Wallace, Joseph Gottlieb Koelreuter, Robert Bakewell, Wilhelm Rimpau, Ephraim Wales Bull, Peter M. Gideon and Joseph Lancaster Budd.

BACK NUMBERS OF THE ANNUAL REPORTS

Proceedings of the American Breeders Association, Annual Reports Nos. IV and VI, may be obtained from the Secretary at $2 per volume. In the case of Annual Report No. VI, this price also covers the four numbers of the *American Breeders Magazine* so long as the supply of the latter publication lasts.

EXTENDING A. B. A. MEMBERSHIP

A small, neat card containing on one side an invitation to join the American Breeders Association and on the reverse side a blank application for membership is being sent out by the Secretary in any desired quantity to members interested in increasing the membership and who will insert these cards in letters with their correspondence. These invitations if signed by the nominating member may carry considerable weight in inducing others to join. In many cases

these slips may serve to call the attention of persons to the work of the Association who before had no knowledge of its existence. These slips are letter size, put up in neat pads of about seventy and will be supplied on request to any member or others interested.

Notices for renewal of memberships are being mailed from the office of the Secretary and members are requested to assist in simplifying this part of the office work, as well as reducing the expense connected therewith, by remitting their 1911 membership fees promptly on receipt of notice. If possible, the fee for at least one new member should accompany each renewal.

OPINIONS

The *Magazine* is good and ought to have a large circulation.—JOHN W. TITCOMB, *Commissioner, Department of Fisheries and Game, State of Vermont.*

I am very glad indeed to see that the *Magazine* is giving so much attention to eugenics. The subject is one in which our people should be a great deal more interested than they are at present, and the American Breeders Association can do a splendid work by keeping the matter prominently before those whose immediate concerns do not take them into this most important field. The last number of the *Magazine,* which I have read very carefully, is a most satisfactory one. In my talks on eugenics, of which I have given several in this vicinity, I mention the American Breeders Association, and the *Magazine,* as deserving the support of everyone who has any concern for the welfare of the race.—ROBERT DEC. WARD, *Harvard University, Cambridge, Mass.*

I wish to express my appreciation of the excellent matter contained in the Reports and in the *Magazine.*—JOHN BELLING, *Assistant Botanist, Agricultural Experiment Station, Gainesville, Fla.*

I congratulate you on the splendid magazine you are getting out. It is a gem. I like the plan of giving the short biographical sketches and pictures of breeders. This will in time form a valuable reference, otherwise not available to most of us.—W. A. HARSHBARGER, *Washburn College, Topeka, Kansas.*

I think the American Breeders Association is doing about the most valuable work of any of the important organizations of this country. For the work in principles of breeding which is given to the seniors in this institution, I very frequently refer to the reports of the American Breeders Association.—ALFRED ATKINSON, *Department of Agronomy, Montana Agricultural College, Bozeman, Mont.*

THE AMERICAN BREEDERS MAGAZINE

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CONTENTS

Benjamin Tomkins, Jr.

THE AMERICAN BREEDERS MAGAZINE

"There is no wealth but life, and if the inherent quality of life fails, neither battleships, nor libraries, nor symphonies, nor free trade, nor tariff reform, nor anything else will save a nation."—SALEEBY.

Vol. II | Second Quarter, 1911 | No. 2

BENJAMIN TOMKINS, JR., 1745-1815.

The difference in quality between the primitive wild cattle of Europe and the common native cattle as owned by the better farmers two hundred years ago was probably not so great as the difference between the latter cattle and the purebred registered breeds of cattle of today.

Two masters who took as their raw material the native cattle of the district in which they lived and created out of that blood a new and distinct breed were Benjamin Tomkins, and his son, Benjamin Tomkins, Jr. The Hereford breed of cattle was their creation. Early agricultural writers and historians frequently confounded these two men, referring to them as one person. But Mr. W. H. Bustin of Hereford, England, discovered records which went to show that the father, Benjamin Tomkins, Sr., began the systematic breeding and improvement of the cattle of Herefordshire in 1742, before the birth of his more widely known son.

The grandfather, Richard Tomkins, had owned and bred Hereford cattle all his life. But the idea of systematic improvement of the cattle strains for a specific purpose was original with his son Benjamin Tomkins and was continued by his grandson, Benjamin Tomkins, Jr. Hence these two men may be said to be the first to have conceived the idea of breeding these cattle especially for beef purposes. The beginning of their operations as originators of modern plans of breed improvement antedates Bakewell's with sheep and cattle.

The periods of activity of the Tomkinses, senior and junior, overlap. The father began his breeding operations in 1742 and continued till 1789. The son began active work in 1769 and carried it on until his death in 1815. During this total of seventy-three years they wrought together for a period of perhaps thirty years. It is also interesting to note that for nearly thirty years after the death of Benjamin Tomkins, Jr., his breeding work was continued

by his daughters, and they are credited with having used good judgment and having been successful.

Benjamin Tomkins, Jr., was a quiet, steady, and patient worker; with consummate skill he built up his breed, refusing nothing good from outside herds, but clinging steadfastly to the plan of using bulls only of his own breeding, and this practice was continued by the daughters during the time they were in possession of the herd.

Tradition has it that three cows formed the original foundation of the Tomkins breeding operations—Pigeon, Mottle, and Silver. From Silver came the Silver Bell who is considered to have been the individual most potent in the early improvement of the breed. It is quite possible that Tomkins discovered that he had a strain of blood which when narrowly bred would produce splendid animals and that this closely bred stock was uniformly better than that produced by outcrossing. This may have been another case of mutation and of a breeder who fell into the plan, or philosophically adopted the plan, of inbreeding until he had made a distinct breed, combining excellence of individuality and potency both for pure breeding and upgrading.

At the time when Tomkins, Jr., was busily engaged in his work, he had no idea that soon a period would come when agricultural conditions on the North American continent would undergo an almost magical transformation, and that on hundreds of thousands of farms a live stock industry would develop in which his favorite cattle would play an important part. The transportation of this breed from its English home, and its perfect and instantaneous adaptation to the entirely new and different conditions and to a variety of climates on the American continent, is certainly the most noteworthy incident in the history of the cattle of Herefordshire.

The magnitude of the breeding operations carried on within this breed at present and the amount of wealth directly produced by them annually would be difficult to compute. This fact, however, boldly stands out: The breed developed on the 300-acre farm of the Tomkinses has spread over and enriched the agriculture of at least three continents. The stream of potent blood from the small nucleus herd has widened until it is now carried in the veins of hundreds of thousands of cattle beasts, vitalizing the agriculture and commerce of many countries.

HORSES AND HORSE BREEDING

H. K. Bush-Brown
Washington, D. C.

Horse breeding has been followed as a trade ever since animals were first domesticated, but for only about a century have stud-book records been kept of the breeding of the different families of horses. The study of types has only quite recently been taken up by men of science with a view of ascertaining the origin of the species and to differentiate their characteristics.

As a result of this study, based upon those anatomical differences and variations which have resulted from wide geographical distribution, and which probably originated in early geological times, it may be accepted that there are four families or species of horses.

The first type in this classification is the Celtic horse, found on the west coast of Norway, known as the Fjord horse in Iceland, Faeroe, Barra, and other small islands of the outer Hebrides, in northern Scotland, on the Shetland Isles, and in Connemara or northern Ireland. There has also been found a close kinship between the Celtic horse and the true Tarpan horse of Russia. The principal characteristics of this type are that, in common with the asses and zebras, it has no callosities on its hind legs, and has a black stripe the entire length of the back and through the tail. It is also frequently striped on the legs and shoulders like the asses, and is of a brown or light dun color.[1]

Nature establishes harmonious groups of plants, trees, and animals, and, certain conditions of climate being given, certain groups of animals and plants are found associated. The small red deer of Norway was an original associate of the Celtic horse, and as this deer is related to the red deer of some parts of France and of Spain, also of Sardinia and the Barbary States, the question naturally arises whether the small ponies of those same regions, though now known only as domestic animals, may not be proven to be kindred to the Celtic horse. If the characteristics mentioned above are present in any measure it would seem to prove the point. Scientific research in this direction has not been pursued, and an inviting field is open to any one who cares to follow this subject further.

The second type of horse is the Prejevalsky, found in a wild state on the steppes of central Asia. There are a few of these in England on the estate of the Duke of Bedford, and several specimens are

[1] The origin of the So-Called Atlantic Animals and Plants of Western Norway, by Leonhard Stejneger. Report Smithsonian Institution, Washington, D. C., page 470.

Fig. 1.—Example of One Type of the Celtic Pony Family.
Showing bars or stripes of dark color like the zebra.

being bred in the New York Zoological Gardens. The Prejevalsky horse is of a red brown color with a light "mealy" nose, has a large head in proportion to his body and is "cat hammed," and less powerful than the Celtic horse. Some writers have assumed that the Tarpan and the Prejevalsky horses belonged to the same family, but this is not now accepted, on account of their marked differences, the most conspicuous of which is that the Prejevalsky has the callosities on his hind legs. In this family it usually takes the form of a narrow strip and not drop-shaped as is common with other horses.

FIG. 2.—FOUR-YEAR-OLD NORWAY FJORD HORSE.
Bred at the Nordfjord Stud, Barrytown, N. Y.; 14 hands; 850 lbs.; shows zebra-like bars on his legs and black stripe in mane.

Prof. Henry Fairfield Osborn of the New York Museum of Natural History has given an interesting account of this horse in a pamphlet and compared him with the drawings on bone of the cave dwellers, the first known picture of the horse, and their characteristics seem identical.

There has been a suggestion that this little horse, only twelve hands high, is the living example of the original ancestor of the draft horses of Europe, but it seems highly improbable, inasmuch as fossils of the draft type have been found showing its great antiquity, and I am more inclined to believe that these big types are a species by themselves. Therefore, I shall so class them until there is more evidence to the contrary, and call this family the third type. This horse is known to science as the Forest horse because he originally obtained his food by browsing on shrubs and low trees. This location of his food set his head at right angles to his neck, which is in strong contrast with the Celtic and also the Arab horse. The head of the Forest horse is long and narrow and the face is particularly long from the eyes to the nose. The

Fig. 3.—Celtic Pony Developed in Norway for Show Purposes.
He shows the characteristic black mark down his mane.

eyes are set well in the skull instead of projecting like those of the Arab horse. These characteristics of the head are dominant, that is, transmitted to the hybrid descendants. This phase of the subject I shall dwell on later.

The Arab or African horse forms the fourth type in our classification. His food is the grasses that grow on the ground and his home

Fig. 4.—Prejevalsky Horse in New York Zoological Gardens.

has always been the open plains and hillsides remote from forest. Therefore his head is articulated on his cervical vertebra at an obtuse angle, thus forming "Hogarth's line of beauty." This set of the head has long been recognized by breeders as a constituent element of beauty, but I think it has not before been explained in this way.

In the forearm of the Arab horse we find the ulna differently developed from that of the European or Forest horse, but this is of minor consequence to breeders. The principal anatomical difference

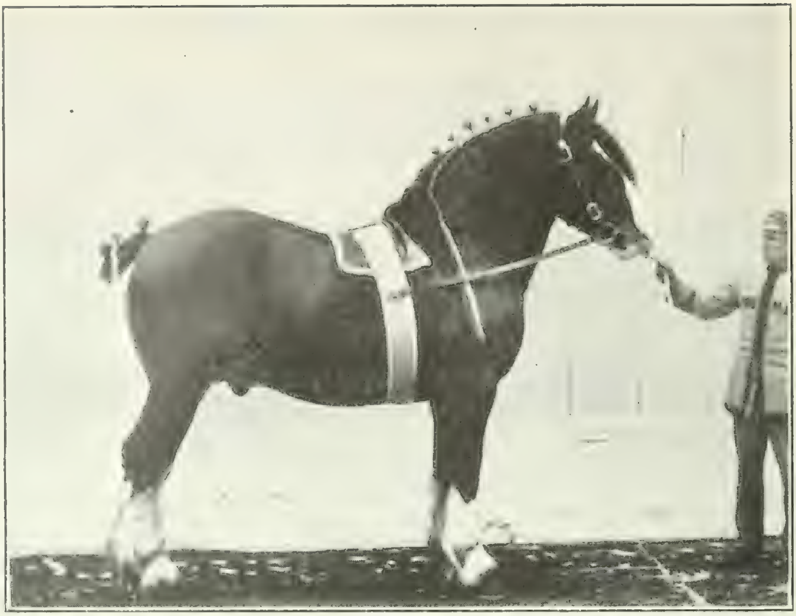

Fig. 5.—Mazemoar Harold.
Champion Shire stallion, aged 7 years.

Fig. 6.—Wydeland's Starlight.
Champion Shire mare, aged 8 years.

between these two families of horses is in the fact that the European draft horse, like all other families of the horse, has six lumbar vertebræ whereas the Arab horse has but five. This difference in their structure seems to me one of great importance to horse breeders. It probably explains why the Arab horse, which is small in size, is capable nevertheless of carrying great weight and possesses such marvelous endurance. The back is strong because it is short between supports, which is an axiom of engineering in bridging. To what extent

FIG. 7.—BARON'S VAUCHER.
Champion Clydesdale stallion, aged 6 years.

this endurance and the short back are transmitted to the hybrid offspring of the Arab and the Forest horse has never been determined by sufficient scientific research. So far as I have been able to ascertain, all horses other than the Arab have six lumbar vertebræ.

The Thoroughbred horse with 75 per cent or more of Arab blood seems to have developed certain peculiarities in the lumbar vertebræ, judging from the two specimens it has been my privilege to study. In that of Lexington in the National Museum at Washington there seems to have been an effort on the part of nature to eliminate the sixth vertebra to the extent that it is much reduced in size and the spine inclines towards the tail like the sacral vertebræ instead of toward the shoulders like the lumbar vertebræ. All sacral vertebræ

are coalesced together, but this sixth lumbar is not at all coalesced with the sacral. Were it so, there would have been six instead of five sacral vertebræ, which is normal. Thus nature, in an effort to eliminate, reduced the size and gave it intermediate characteristics, partly sacral and partly lumbar.

These same peculiarities of the sixth vertebra may be seen in the skeleton of the rearing horse in the Museum of Natural History in

FIG. 8.—GEORGE.
Percheron.

New York, but unfortunately his pedigree has not been preserved, so we can only assume that he was a Thoroughbred of high type.

In the case of Sysonby, another Thoroughbred, whose skeleton is in the Museum of Natural History in New York, the sixth lumbar vertebra is fully developed in size, but is thoroughly coalesced with the fifth, making a double bone and thus greatly strengthening the back at its weakest point. This is not uncommon in other horses. It does not occur, however, in the two trotters I have examined. Are these two animals merely individual freaks of nature or do they

FIG. 9.—SKELETON OF ARAB HORSE.
Articulation of head on cervical Vertebra and Hogarth's line of beauty superimposed.

FIG. 10.—SKELETON OF ARAB HORSE NIME.
Showing five lumbar vertebrae, Museum of Natural History, New York.

appear in all or most Thoroughbreds? And had the structure of Lexington's back anything to do with making him the greatest 60-mile horse of the world? Or Sysonby's with his noted performances?

The Thoroughbred horse is a product of breeding the Forest mare to the Arab horse until only a small portion of the Forest type remains, and if therefore the sixth lumbar vertebra always asserts itself, it leads to the statement that under such conditions of breeding, the sixth vertebra is a dominant quality. I have asked what the

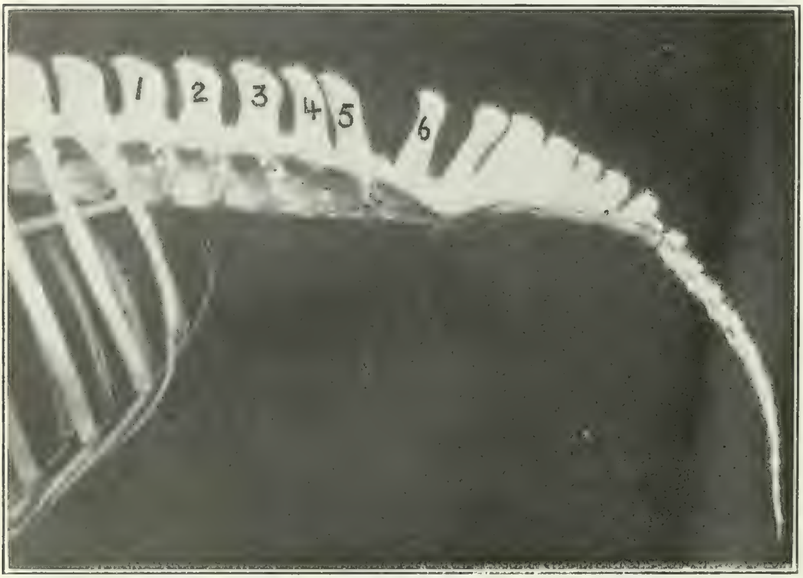

FIG. 11.—LEXINGTON.
Showing sixth lumbar vertebra of indeterminate character.

result is when the breeding is reversed, the mare being a pure Arab with her five lumbar vertebræ and the sire being some hybrid of the Forest horse. This question has not yet received an answer. I made one dissection of a foal of this breeding and found but five lumbar vertebræ; this dissection I have deposited, with its pedigree, in the Museum of Natural History of New York. There are in the United States half a dozen mares bred in this way from pure Arab dams and trotting stallions.

It seems to me important that these mares should be carefully bred, some to trotting sires and some to Arabs and the produce compared. Finally when the produce die, their backs should be dissected and if it be found that most of them have only five lumbar

vertebræ, then we may assume that the five-vertebræ structure is dominant when breeding hybrids from the dam of that type. We know it to be recessive, that is the six are asserted, when breeding hybrids by the use of the sire, as shown in Thoroughbreds examined. I shall illustrate this point in another way from known facts.

Fig. 12.—Rearing Horse of Unknown Breeding.
Showing position of the sixth abortive vertebra, Museum of Natural History, New York.

When Professor Stejneger was travelling in western Norway he made a special investigation as to what proportion of the horses in common use had the callosities on their hind legs, and was not a little surprised to find that they were so commonly without them and that

where present they were extremely small, that is, the horses were relatively pure to the type of their Celtic pony ancestors.

The mixing with other types had of course gone on for centuries in a moderate degree, and probably during the last half century has been by use of sires of other types, yet the tendency has been in the direction of a stronger influence of the dam, and when callosities were present they were exceedingly small.

Now let us see what happens to the callosities when the ass, which has none on the hind legs, is bred to the mare which is possessed of them. The mule follows the female and nearly always has them. Thus again does the dam have the greater control over the physical characteristics, and callosities are dominant.

Shall we assume, then, that in breeding the pure Arab mare with five lumbar vertebræ to the horse that has six that the produce is more likely to follow the anatomy of the dam? Here is an opportunity to pursue an original line of research that will be productive of very beneficial results to horse breeders. Certain it is we want to breed for the best results and this is a line of investigation that if pursued seriously on parallel lines for a number of years will demonstrate a lot of things that we do not know at present.

The Arab breeders aways trace the pedigrees of their horses from the dam, and being also careful of the quality of the sires, have maintained purity of type in their horses.

I believe that it will be acknowledged by all breeders in America that those who give their greatest attention to the physical quality of their brood mares have the most uniform and highest quality of offspring. If it can be shown by following the line of anatomical research indicated above that the dam has a preponderance of influence over the anatomy of the foal, a more careful selection of dams will be adopted by breeders.

By following a system of registration that gives all prominence to the sire we have been misled into believing that the sire is the all-important consideration in breeding, and seriously uncertain have been the results in following this method.

I am told on good authority that in horse breeding Mendel's law is applicable only when breeding is within the family, and that is crossing species a new and unknown ratio of inheritance of characteristics is established. This I shall leave to others to work out, but before leaving the subject I should like to inquire of breeders what becomes of the callosities when a hinny is produced by breeding the stallion to the jennet. This has been done only occasionally, but

by analogy I am prepared to find that the callosities are very rarely transmitted to the offspring. Definite knowledge on the subject would certainly elucidate the argument.

Fig. 13.—Salvator.
Imported Thoroughbred, showing Hogarth's line of beauty in neck.

[continuation in next number]

THE AGE FACTOR IN REGISTER-OF-MERIT JERSEYS

E. N. Wentworth
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Some time ago, in connection with the various factors that influence maturity in animals, the age of parents at time of conception came under discussion. While there is little or no experimental evidence with respect to animals, yet the common practices of plant breeders in developing plants in more rigorous climates evoked the belief that youth in either parent at time of conception might modify the matu-

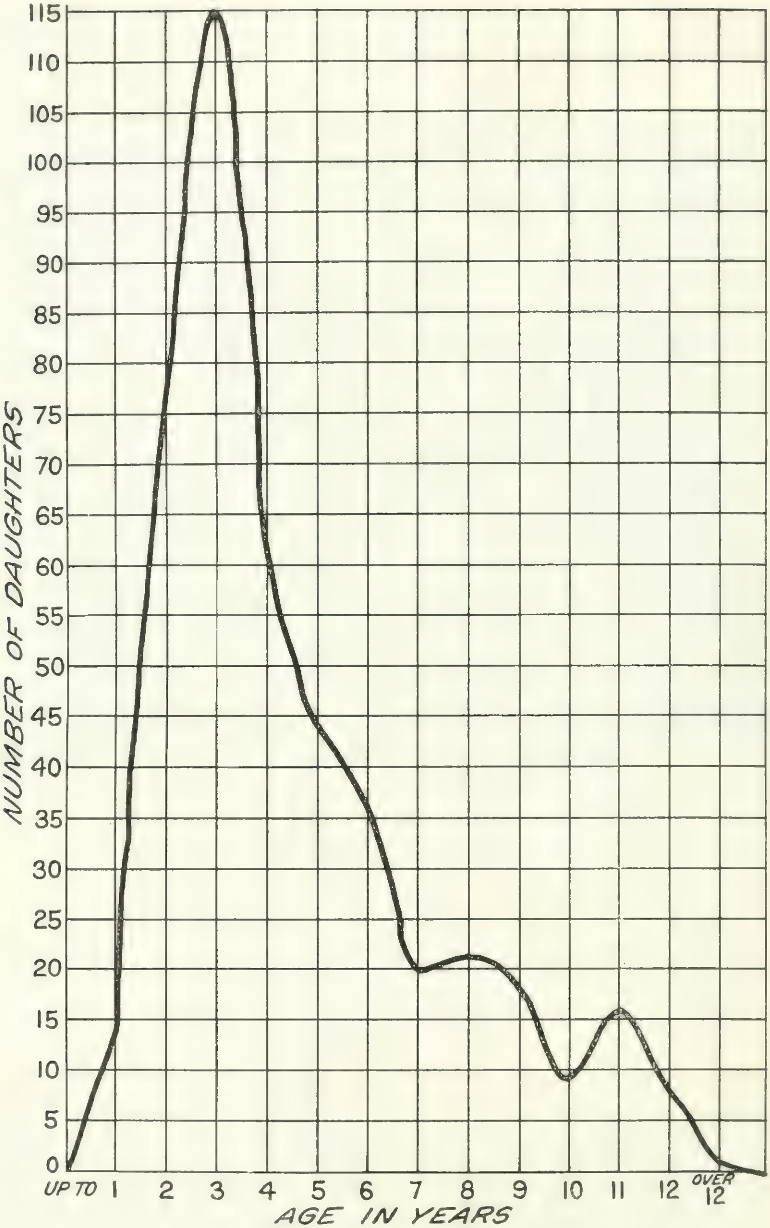

FIG. 1.—AGE OF SIRE IN RELATION TO NUMBER OF DAUGHTERS.

rity factor. With this idea in mind an examination of Jersey cows in the Register of Merit with reference to their sire's age was conducted and the curve in Fig. 1 plotted.

The result, to say the least, was surprising. While many breeders follow the practice of developing young bulls, yet it was surprising to discover that such a large percentage of the animals of the breed were the offspring of young animals. As can be plainly seen, 46.8 per cent of the animals were sired by bulls under three years of age, or nearly half of the number studied. In explanation of this it

FIG. 2.—AGE OF SIRE IN RELATION TO NUMBER OF DAUGHTERS IN THE REGISTER OF MERIT.

has been said that breeders try a young bull and then sell him to men that do not put their females in the Register of Merit. While this may account for part it does not seem that all animals are thus answered for.

In order to study the distribution more thoroughly a second curve was plotted using a half year for the age unit rather than one year. This curve shows that 16 per cent of the total sires of the breed are from two years one month to two years six months old at time of service; 10.3 per cent are from two years seven months to three years. This is shown in curve, Fig. 2.

In order to compare the age of the sire with the age of his daughters at the time these made their record (the only index for maturity and that not absolutely satisfactory) a table was compiled which brought

to light an interesting fact. The average age of sires is four years and six months and the average age of daughters at time of record is the same. However, viewing this from the standpoint of the correlation coefficient the relation between variations in age is only casual, as a coefficient of ±0.5269 is not high enough to suggest any marked relation. One factor which may modify this and which perhaps if omitted from figuring might produce a closer correspondence, is the fact that a bull comes to service at a much younger age than a cow comes to milking power. If these thirty-eight young bulls were left out, a much larger coefficient could be established. Another peculiar fact is that the modal age is the same, for both sire and daughter or, in other words, the typical age, 2-2½ years, is the same both for service and for record making.

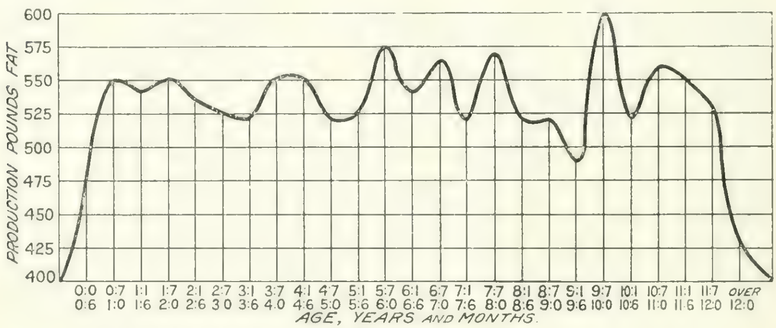

FIG. 3.—RELATION OF AGE OF SIRE TO PRODUCTION OF DAUGHTER.

The relation of age of sire to production of cow was tabulated, and a higher coefficient of correlation ±0.6647 was found. The curve plotted from the table, however, shows very little of value, as only in the center of the curve is there found a strong tendency to positive correlation, a gradual increase in the curve (see fig. 3) in the younger ages being more than offset by a decrease in highest ages.

Next in order a table was compiled in which the production of the cows was all put on the same basis. Week records were discarded and only the year records and the three months records at St. Louis were considered. These latter were assumed to equal about two-fifths of the year's production, while the former were all put on a similar basis (that of the mature cow) from the standpoint of age. For example Brown Lassie's Prize 192584 made a record of 325 pounds 8.8 ounces, beginning at two years and two months old. The advanced registry requirement for that age is 250 pounds of butter-

fat in a year, while the requirement for a cow five years old or over (mature) is 400 pounds of butterfat. This difference in requirement is due to the increased capability of the cow as a producer when she matures. Then a record of 325 pounds of fat at two years two months is greater than the same record at five. To put these on a similar basis, direct proportion by means of the standards fixed by the American Jersey Cattle Club were used. Under this condition 325 pounds 8.8 ounces of fat in the "under thirty months" form equals 500 pounds 13 ounces in the mature form. Putting all records on this basis, the average production of all of the Jersey cows in the Register of Merit is 526 pounds 8 ounces.

Table 1 shows some interesting figures derived from this work. The sires have been divided equally into three groups, dividing the range of age into thirds, rather than grouping into equal numbers of sires. In only one case does the oldest group of sires lose anything to the younger, in spite of the larger number of younger animals. In average production the middle and younger sires have the advantage. In number of performers above the average in each group, and in relative early maturity of daughters, the younger and middle aged sires must yield to the older; as compore 523 pounds 7 ounces and 530 pounds 2 ounces with 513 pounds 15 ounces. In the case of maturity this is directly opposite to our plant breeder's experience. However, the relatively small number of old sires introduces a greater probable error, so great as to leave doubt in the mind as to the value of drawing conclusions.

In the course of the work one or two interesting facts came to light which are partial remuneration for the negative results of the preceding work. In the majority of cases there is a direct correlation between the high lactation period of the cow and the merit of calf which preceded this period. Presumably, however, this difference lies in the superabundance of vital force the cow possessed at this time and the energy thus transferred to the offspring.

Another fact which came out was the relatively large number of bulls which seemed to sire most of their Register of Merit daughters within one season. One can scarcely claim that the point needs explanation other than the ordinary factors of buying, selling, advertising, and the succession of a new bull as head of a herd of productive cows; yet the point is worthy of note, as it may be that in our highly artificially bred domestic cattle the greatest efficiency of reproduction is a sadly limited period.

TABLE 1.—*Three age-groups of sires with average production and age of respective groups of daughters.*

Age of sire.	Daughters.				
	Total number.	Number above average.	Per cent above average.	Average individual production.	Age at time of record.
yrs.mo. yrs.mo.			*per cent*	*lbs. ozs.*	*yrs. mos.*
0 : 0—0 : 6	3	0	0.00	471 : 1	5 : 5
0 : 7—1 : 0	9	4	44.44	532 : 11	4 : $2\frac{4}{9}$
1 : 1—1 : 6	26	10	38.46	546 : 8	4 : 7
1 : 7—2 : 0	27	15	55.55	533 : 5	4 : 1
2 : 1—2 : 6	54	21	38.88	519 : 0	4 : 2.5
2 : 7—3 : 0	31	9	29.03	507 : 1	4 : 9
3 : 1—3 : 6	26	8	30.77	509 : 14.4	4 : 4
3 : 7—4 : 0	23	11	47.83	536 : 15.5	6 : $\frac{5}{10}$
Average........	....	....	39.2	523 : 7	4 : 7.4
Probable error..			±0.99	......	....
4 : 1—4 : 6	23	11	47.83	540 : 6.4	3 : 9
4 : 7—5 : 0	15	5	33.33	503 : 10	4 : 2
5 : 1—5 : 6	19	8	42.11	510 : 14.5	4 : 8
5 : 7—6 : 0	16	9	56.25	560 : 8	4 : 10
6 . 1—6 : 6	8	4	50.00	530 : 3	4 : 7.5
6 : 7—7 : 0	8	5	62.50	549 : 7.5	5 : 10
7 : 1—7 : 6	12	3	25.00	505 : 5	4 : 2
7 : 7—8 : 0	6	4	66.66	560 : 0	5 : 7
Average........	....	....	45.80	530 : 2	4 : 6.3
Probable error..			±2 78	......	....
8 : 1— 8 : 6	7	2	28.57	514 : 4.8	3 : $1\frac{5}{7}$
8 : 7— 9 : 0	7	2	28.57	502 : 12	4 : 5
9 : 1— 9 : 6	2	1	54.00	499 : 15	3 : 8.5
9 : 7—10 : 0	5	4	80.00	430 : 4	4 : 4.6
10 : 1—10 : 6	10	3	30.00	511 : 12.7	3 : 6.5
10 : 7—11 : 0	7	5	71.43	592 : 38	4 : 1
11 : 1—11 : 6	2	1	50.00	535 : 12	3 : 6.5
11 : 7—12 : 0	6	4	66.66	522 : 3	4 : 4.6
over 12 : 1	1	0	00.00	412 : 0	2 : 0
Average..........	....	....	46.8	513 : 15	3 : 11.7
Probable error....	....	....	±5.70		
Total.........	353	149	42.21	....	....

Another interesting point lay in the relative influence in inheritance between the bull and the cow in the production of sons capable of siring Register of Merit daughters. Without transposing the records to the basis of the above work, a coefficient between the sire and son of 0.821 existed, while the transposed records gave a relationship of 0.862. Taking the latter relationship with the cow the coefficient 0.727 was derived. This would show a slightly stronger influence for the bull, but as the number of cases was smaller with the cows the

probable error would be enough larger to nearly neutralize this difference. This should set at rest the minds of many dairymen who believe that a dairy bull from a high performing cow is of more value as a sire than a bull whose daughters have proven worthy of registry. It furthermore brings a closer harmony with the theory of the equal potency of parents, something which practical men have hesitated to accept.

In conclusion it may be said that deductions from this work are practically impossible. While the introductory curves are somewhat surprising, a detailed study fails to show a strong correlation between any age of sire and maturity or production of the offspring. The premises may not be correctly taken, but it seems to the writer they are nearly enough so, to assure him of the lack of age as a factor in the conditions studied.

YIELD TESTS AS A BASIS OF AWARDING PRIZES AT CORN SHOWS

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The corn show has without doubt been an important factor in the development of interest in our principal crop. Competition is a powerful incentive, and encourages attention to details and minor differences that would be overlooked without this stimulus. In fostering competition, however, care should be taken that the competition is making in the direction of real improvement.

The avowed object in awarding prizes in corn contests is to give credit to the best exhibit of corn, that is, the exhibit of corn which it would be most profitable to grow[1] a worthy object which it would seem should eliminate from a score card any character not correlated with high performance.

At the time that score card methods were applied to corn judging, almost nothing was known regarding those characters of the ear which are associated with high yield. In the absence of experimental data the choice of points would seem to have been based on the idea that the size of the cob was fixed and the best ear was the one that approached the nearest to the maximum amount of grain that could

[1] See Bowman and Crossley, Corn, p. 406, and Ohio Agricultural Experiment Station Circulars Nos. 43, 61, etc.

be placed on the cob. Hence the straight rows, the cylindrical ear, the wedge-shaped grain, the rounded butt and tip, and the recapitulation of all these in the per cent of grain to cob. In only a few cases have the values of these characters been put to the test, but what evidence there is seems to indicate that most of the score card characters have nothing whatever to do with yield and some of them seem to be actually correlated with low yields, instead of high yields.

Competitive corn shows simply adopted methods already in use with live stock, fruit, flower, and vegetable exhibitions. With these products appearance is closely associated with market value, while in corn appearance is of little importance, a fact which made the older methods more or less inapplicable.

A further distinction between corn and most of the earlier classes of exhibits is the fact that corn is an annual. With live stock and perennial plants, though conformity to a score card may not indicate a high degree of commercial superiority, there is at least the satisfaction of having a beautiful and relatively perfect animal that continues to be a pleasure year after year. But with corn the pleasure derived from the production of prize-winning ears is very short-lived, unless they are kept as decorations or mementos of victory.

The repeated demonstration that the characters used as the basis of scoring stand in no definite relation to performance has caused a widespread reaction against the present method of awarding prizes. In recent years the attempt has been made to meet the difficulty by awarding prizes for the largest yield per acre, but this is not proving satisfactory. Profit and not yield per acre is the object of the farmer. The premium in such cases might with equal propriety be awarded for the best fertilizer or the most productive land. In a few cases prizes have been offered for the greatest net return per acre, but the opportunities for deception are so tempting and the difficulties of securing accurate data are so great, that competitions of this kind are not likely to become popular. Furthermore, profit per acre does not center the attention on the improvement of the corn, and while increased profits are desirable, such an exhibit should be called a competition in farm management and not a corn show, the object of which is the improvement of corn varieties.

The real difficulty would seem to lie in the attempt to combine the awarding of prizes to handsome ears and high yielding ears at the same time. Confusion and dissatisfaction will continue until the two objects are recognized as distinct and prizes are awarded accordingly.

There would seem to be no reason why there should not be corn fanciers as well an fanciers of live stock, but let us not confuse the appearance of the ear with its value as seed. If the judging of corn on the appearance of the ear can once be separated from the attempt to recognize its value as seed, the score card can be freed from such vague and meaningless terms as "breediness" and "constitution," and the judging can be based on definite characters capable of accurate application.

To secure the full advantages of competition in the improvement of corn varieties, it will be necessary to provide a class, in which a premium is awarded to the exhibit, *capable of producing the largest amount of marketable corn under given conditions.*

A suggestion that premiums be awarded for high-yielding strains of corn has been made by Mr. D. A. Saunders, special agent of the Department of Agriculture in Texas. It seems to obviate most of the objections to present systems, and while retaining the advantages of competition would cause it to bear directly on the improvement of corn varieties. The method is certainly worthy of careful consideration by corn growers' associations and other organizations interested in the improvement of corn.

One way to utilize this suggestion is that the corn growers' association, or whatever organization is managing the competition, arrange with the state experiment station or nearest branch station to plant seed from each of the entries in a comparative yield test, the award to be made to the exhibit producing the highest yield. The exhibits would need to be submitted in the spring in time for planting and should consist of ten ears. One-half the number could be taken at random, the seed shelled and thoroughly mixed before planting.

The test could be made by planting a single row from each lot and repeating the series three or four times, a method that is proving more satisfactory than that of planting in plats. In this way the area required for testing the exhibits of an entire show would not be large. With rows 100 feet in length and repeating the series four times at least twenty-five exhibits could be tested on an acre.

The date of harvesting could be announced and the exhibitors and all others interested could be invited to attend when the corn is harvested. The general appearance of the crop as well as the characters of the plants could then be observed.

The corn should then be stored and the final weighing made at the time of holding the show. This would take place at the usual time.

when the corn would all be air-dry and the yields comparable. The five ears remaining of each of the original entries could then be placed on exhibition, with a statement of the yield.

The educational value of an exhibit of this kind would be much greater than that of the conventional form. The grower would have the opportunity to see exactly how his corn had behaved in comparison with other varieties. Significant characteristics of the high-yielding strains would be apparent and readily brought home to the actual breeders and growers.

Objection might be raised on the ground that a test made at one place can not do justice to all the exhibits, some of which may have been bred on soil of a different type, or that the planting distance chosen for the yield test is not the best for all the varieties contesting. The same objections apply to all yield tests, yet a yield test is the only method at present available for determining the relative values of different varieties and for measuring the results of breeding. As a criterion for awarding prizes the injustice is certainly less than the present system of score card ratings. The yield test shows that the exhibit awarded first place is really superior to its competitors under at least one set of conditions, while conformity to the arbitrary standard of a score card bears no relation to the performance of the strain under any conditions.

Experiment stations would doubtless welcome the opportunity of making these tests for corn exhibitions, since it affords an excellent means of bringing the farmer and breeder into close touch with the work of the station. If the station has an improved or new variety of corn which it desires to introduce into general use it could be included in the series tested. Though not entered for a premium, any variety that possessed real merit would have attention called to it in a most effective way.

Local associations whose exhibitions are held at places where no station or substation is available for growing the exhibits should have little difficulty in securing the use of sufficient land for the test from private individuals. In such cases it would be necessary that the planting, harvesting, and weighing be done by representatives of the association. The corn, as soon as the yields were determined, could revert to the farmer in return for the use of the land.

REPORT ON THE ORGANIZATION AND THE FIRST EIGHT MONTHS' WORK OF THE EUGENICS RECORD OFFICE

H. H. Laughlin
Cold Spring Harbor, N. Y.

The Eugenics Record Office began work at Cold Spring Harbor, Long Island, on the first of October, 1910. Preparatory to this, however, Dr. Davenport and the writer had trained a class of twelve persons for the duties of field workers. Among other things the work included instruction in the principles of heredity, the distinction between worthless and telling records, and the practical methods of gathering significant data at first hand in the field. The work was novel in the history of training field workers, in that they were trained for the purpose of observing keenly and reporting accurately the facts concerning the family distribution of specific biological traits in human families. This was done because it is now generally recognized that the rapid advance in discovering the laws governing the inheritance of mental and physical traits is due to two things: First, the modern field method of getting at the inheritance distribution of biological facts, and, second, the modern analytical study of these facts, fitting them to the presence-and-absence hypothesis and to the Mendelian principles.

Six of these field workers were retained in the service of the Record Office, as follows:

Miss Florence H. Danielson was assigned to the collection of pedigrees of epileptic families in Massachusetts and Connecticut, under the immediate supervision of Dr. Everitt Flood at Palmer, Mass. Up to the present time she has sent the office 95 pages of charted pedigrees and 286 pages of descriptions. Her work is of special interest in that the families studied are closely related, thus furnishing many samples of a single germ plasm. It is from just such extended pedigrees that the laws of heredity are best ascertained.

Miss Saidee C. Devitt was assigned the duty of working up the pedigrees of epileptic families in New Jersey under the direction of Dr. David B. Weeks of the Skillman School for Epileptics. Miss Devitt has sent in 50 pages of pedigrees and 128 of descriptions.

Mrs. Mary Drange-Graebe was assigned to the study of the transmission of criminal traits, under the immediate care of Dr. William Healy of the Chicago Psychopathic Institute. After four months' work there she began her present assignment—the study of the Ish-

mael Tribe in and about Indianapolis, Ind. This tribe of vagabonds came up from Kentucky into Indiana just a little in advance of the more settled conditions. A generation ago, Dr. Oscar McCulloch, assisted by Mrs. Kate Parker and a Mr. J. F. Wright, began the study of this tribe in just such a manner as the field workers of today are following; the work, however, was too advanced for the times. Dr. McCulloch died and Mrs. Parker found it impossible to continue the work. The original notes were mostly destroyed, a single large volume of pedigrees remaining. This volume Mrs. Parker has turned over to the Record Office, and now Mrs. Graebe will take up the work where it was dropped a generation ago. Up to the present time Mrs. Graebe has sent in 77 pages of pedigrees and 873 pages of descriptions. The traveling expenses for this work are paid for by Mr. W. E. D. Stokes.

Miss Amey B. Eaton, working directly from the Record Office, was assigned to the study of the Amish Sect of Lancaster County, Penn. In this small sect considerable intermarriage has occurred. These people kindly coöperated in our efforts to learn whether, and if so to what extent, these consanguineous marriages had resulted in defective offspring. In her second assignment Miss Eaton catalogued genealogies in the New York Public Library with a view to locating those that record the transmission of specific mental and physical traits. The thing made apparent by this study as far as it has progressed is, that, in the hundreds of genealogies published, there is too little material of use to the eugenist. It may be that at some future time it will become fashionable for genealogies to give in detail a statement of inheritable traits in addition to the names and dates of marriages, births and deaths and the family traditions. Her next assignment was the making of a bibliography of the literature on Huntington's Chorea. Miss Eaton has sent to the office 293 pages of pedigrees and 731 pages of descriptions. At present she is assigned to the duties of editorial secretary at the Record Office.

Dr. A. H. Estabrook was first assigned to western Massachusetts and Connecticut to collect pedigrees of albino families. His second assignment was the study of the factors of heredity contributing to criminal insanity; he was attached to the Matteawan State Asylum at Matteawan, N. Y. He is now working on his third assignment—the study of degenerates in the isolated valleys around the upper Hudson. He has reported the discovery there of a large family with much intermarriage that promises to be as interesting as the "Juke "or the "Zero" family. Dr. Estabrook has sent to the office 35 pages of pedigrees and 168 pages of descriptions.

Miss Helen T. Reeves was assiged to the study of feeble-mindedness in New Jersey under the direction of Dr. H. H. Goddard and was later transferred to the same problem under the direction of Dr. Hallowell of the New Jersey State Home for Feeble-minded Women. At present she is working on an extended network that promises to be very significant: she has sent to the office 76 pages of pedigrees and 84 pages of descriptions.

A tabulation of the field expenses, exclusive of salary and fifteen days' maintenance at the institution from which they work, shows that the average field expense of the work is $54.

In addition to the twelve persons trained during the summer of 1910 for positions as field workers, four others have since received the same training: Miss Moore, sometimes archivist of the Record Office, Miss Sturges, Miss Jones, and Miss Orr. Three of these have received appointments with different institutions. Our own six field workers were selected from the twelve above mentioned. These field workers make a daily report as to their present addresses, their addresses three days hence, their work of the day and their outlook for the next day, and they also send the office a general monthly prospect. Their pedigree charts and descriptive notes are sent to the office for criticism from time to time, and filed at the office upon completion of the record of a single family or tribe. Specially ruled note books with alternating white and yellow sheets—the white detachable—were prepared for the field workers' use, and also note books for written descriptions, similarly bound, were prepared.

Preparatory to a study that it is planned to make in collaboration with Dr. S. E. Jelliffe of the immigration sources, the migration routes, and the specific behavior in heredity of Huntington's Chorea, this office has collected through the collaboration of the various hospitals of the country, pedigree records of 80 families suffering from this disease.

The Record Office has addressed letters to all of the heads of all institutions in the United States concerned with abnormal individuals, inquiring to what extent modern field work is being carried on and to what extent collaboration and exchange of data with the Record Office is feasible and desirable. The replies have been of a most gratifying nature, as the heads of the institutions generally recognize that the time is ripe for a concerted study looking to the discovery of the causes of defects and the circumscribing of the affected germ plasm. The need of a clearing house is made apparent by the fact that from time to time the pedigrees begun by eastern investigators come to an abrupt

end by simply stating that the family moved to such and such a western State at such and such a time. Those in charge of the western institutions, while taking more than average interest in the movement, realize that in their country, because newly settled, the tabulation of extended pedigrees is usually impossible; they feel that pedigrees begun by their investigators will end before progressing very far by simply recording: "Further history unobtainable, family came from such and such an eastern place at such and such a time."

The work of the Record Office is not confined to the study of abnormal traits, interesting as these may be in throwing light on the principles of heredity and in discovering the laws that will lead to the prevention of the production of defective persons, but it also includes the study of men of genius and to this end a schedule has been prepared, which will be sent to any persons in the United States who have developed special talents in some direction and who care to coöperate in the investigation to the extent of supplying their own biological history.

The Record Office has begun a cross-reference index of the names, traits, and localities included in all the data received. It is believed that this index will be useful in tying together fragmentary pedigrees and in tracing back to the earliest ancestor significant hereditary traits. The office is now prepared to index any material, no matter how fragmentary or how extensive, concerning the transmission of biological traits in man; and it seeks to become the depository of such material.

The heads of the State institutions in New Jersey, New York, Massachusetts, Connecticut, Wisconsin, Michigan and Illinois (in so far as they are not now making investigations in heredity) have by their replies indicated that conditions in these States are such as to warrant the employment of field workers in the near future. Other States, while looking with favor on the movement and desiring to coöperate, feel that the time is not quite ripe for application to the legislatures for the necessary funds.

Provisions have just been made for the publication of the Eugenics Record Office Bulletin, which will consist of brief papers by investigators in eugenics and will for the most part be based on facts gathered in the modern way by the field workers of and collaborators with the Record Office. Bulletin No. 1: Heredity of Feeble-mindedness, by Dr. H. H. Goodard, was issued in March, and Bulletin No. 2, The Study of Human Heredity, methods of collecting, charting and analyzing data, by C. B. Davenport, H. H. Laughlin, David F.

Weeks, E. R. Johnstone and Henry H. Goodard, was issued in June. Bulletin No. 3, by Gertrude L. Cannon and A. T. Rosanoff is entitled: Preliminary Report of a Study of the Heredity of Insanity in the light of Mendelian laws. It is the intention to use these bulletins, to show the heads of institutions, boards of control, private investigators, genealogists, and legislative authorities just what can be done and is being done by the modern methods of investigation. It is hoped to arouse the conviction that data, adequate to the deduction of the laws of inheritance, and studies preliminary to wise legislation looking to the prevention of the production of defectives, can be got only by sending trained field workers into the home territories of the families studied, and to bring it about that the board of control of each State institution shall maintain one or more such workers on its staff. The movement is progressing very satisfactorily indeed.

The "Family Records" and "Record of Family Traits" schedules are being distributed to persons who will undertake to fill them out and deposit them at this office. Over 7000 of these have been placed with genealogists, teachers of biology, and other interested persons most able and likely to fill them out. Forms calling for data on the inheritance of factors contributing to mathematical ability have been prepared and are now being distributed; the principal collaborator in this work is Prof. H. Clay Harvey. Also forms of the same nature but somewhat more detailed have been prepared for the study of the inheritance of musical ability. The factors most likely to be contributory to the contraction of tuberculosis have been charted, and schedules calling for the family history of these particulars have been printed; about 2000 of them have already been placed. Dr. A. E. Kepford, the State Tuberculosis Lecturer of Iowa, is actively collaborating in this work, and favorable replies have been received from State sanitaria and private persons looking to the collection of authentic pedigrees that will enable careful study to be made of the behavior of hereditary resistance and non-resistance to this disease.

Correspondence, seeking to locate the original notes of the late R. L. Dugdale—which notes he made while gathering data as a basis for his book on the "Jukes"—has been carried on. After hearing from all his executors and from all associates in his work that are still living, we are convinced that his manuscript was destroyed upon the death of his sister in 1884. However, the original prison records exist and the Record Office will shortly take up the work where Dugdale left off. It is known, that many other Juke-like families exist, and our field workers' reports assure us that many such pedi-

grees can be worked out. The work of Dugdale on the "Jukes," like the work of McCulloch on the "Ishmaels," was a generation ahead of its time.

The purpose of the Record Office is the collection of data adequate to the determination of the laws of inheritance; to be a clearing house in matters pertaining to human heredity; to aid in the extension of the knowledge of the laws of inheritance as these laws are discovered from time to time, to the end that the propagation of defectives may be stopped and the more talented strains may be measurably increased. The work of the first months has consisted in organizing and directing a small field force, trained according to the new ideals; in working out an indexing system making all data possessed by the office instantly accessible; in ascertaining the attitude of institutions and interested persons toward the new investigations and the feasibility of coöperation; and in securing pedigree records of specific mental and physical traits.

The office is situated about three-quarters of a mile from the Station for Experimental Evolution (a department of the Carnegie Institution of Washington) on the State Road leading from Cold Spring Harbor to Syosset, a station on the Long Island Railroad about two and one-half miles distant; the office is about equally distant from Oyster Bay. The main room is 17 feet by 38 feet and a fireproof concrete and steel record room, 14 feet by 17 feet, adjoining the office, is just being completed. Files and indexing material are being supplied as rapidly as needed and an adequate office force is maintained.

THE INHERITANCE OF LEFT-HANDEDNESS

[Continued from First Quarter]

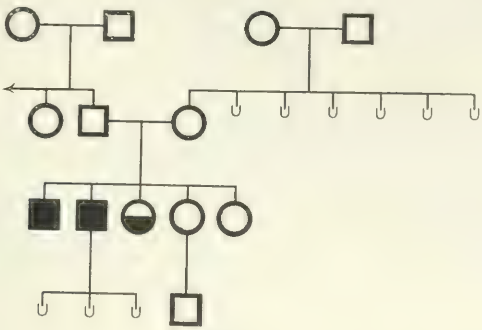

Fig. 3

Fig. 3. Here the childship shows a majority of affected persons.[3] The female is ambidextrous. This family has taken an intelligent interest in the appearance of this variation among the children. The mother assures me that she was never able to learn of any case of left-handedness either in her ancestry or that of her husband. The variation here seems to have arisen spontaneously and in more than half the children.

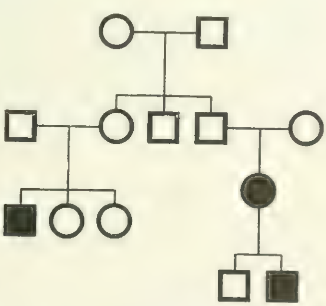

Fig. 4

Fig. 4. This family history indicates that brother and sister were carriers of a latent factor of left-handedness, which characteristic became patent in their children. A Mendelian interpretation here demands that both parents in the two families concerned should

[3] The following symbols are used in the heredity charts: male, right-handed; female, right-handed; male, left-handed; female, left-handed; male, ambidextrous; female, ambidextrous; sex unknown, right handed; sex unknown, left-handed

have been heterozygous with respect to the factors that determine preference for use of one or the other hand. Possibly many so-called right-handed individuals are heterozygous in regard to these factors.

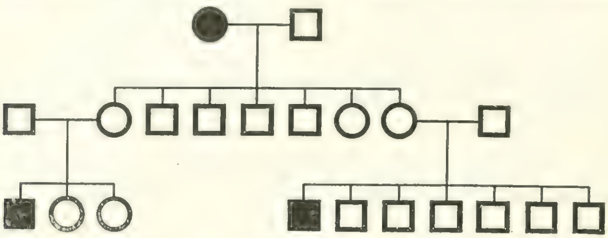

FIG. 5

Fig. 5. Here again two individuals (females in this case) appear to have acted as carriers of a factor transmitted from the father and through them to their children. If we assume here, as we must on a Mendelian stand, that the mother was homozygous with respect to the left-handed character and the father either homo- or heterozygous with respect to the other member of the assumed pair of allelomorphs, the absence of left-handedness in the second generation is disconcerting but not necessarily subversive of the Mendelian scheme. Assuming again that both parents of the two third-generation childships are heterozygous, the appearance of a left-handed child in each meets a reasonable Mendelian expectation.

As an example of the range of data gathered in every case where possible, the following account of the male of the smaller childship will suffice: Throws ball with left hand; kicks football with left foot; uses knife and fork as do right-handed persons, but holds spoon in the left hand; writes with right hand (though he began to use left, but was forced to change to right by teachers in lower grades of school); shoots gun from left shoulder; shoots marbles with left hand; bats ball from right side of plate; holds drinking glass with right hand; holds pencil on left ear; plays tennis with left hand; starts on running track with right foot at line.

Many other cases simply parallel this one with unimportant variations. The point to be emphasized here is a condition of general left-sidedness (especially left-leggedness, contrary to Sibley's equilibrium theory) coincident with left-handedness.

Fig. 6. The affected individual here is a professor who has taken a deep interest in his own condition and that of his daughter (both inveterately left-handed) and has made a scientific study of the ancestry of himself and wife. He assures me that for three generations

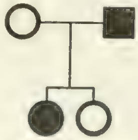

FIG. 6

back on his side and two generations back in his wife's ancestry no left-handedness has anywhere appeared. Here again seems to be a real case of a mutation (spontaneous variation) which again appeared in one of the two offspring.

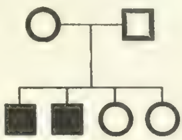

FIG. 7

Fig. 7. This case is interesting in that half the childship (the two halves of opposite sex)[4] of apparently unaffected parents are left-handed. The family explains the case by the fact that the boys had a left-handed nurse, the girls a different nurse.

Thus far, then, we seem to have discovered the influence of at least three factors in the production of left-handed individuals (the condition being probably of at least three degrees or grades of intensity): (1) heredity; (2) spontaneous variation; (3) imitation. More will be said of these three types below.

FIG. 8

Fig. 8. This pedigree shows direct transmission through three generations.

[4] In each of four other childships (comprising a total of 11 girls and 8 boys), which have since come to my notice, the left-handed individuals are all of the same sex (three females each in three cases).

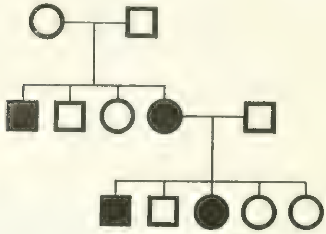

FIG. 9

Fig. 9. This shows the prevalence of left-handedness in a particular family to the extent of approximately half the childship. Having recognized a factor of imitation, the argument might be made that the prevalence of left-handedness in certain families is due to the operation of this factor exclusive of heredity. I am convinced that this is not a valid argument. Families (at least of whites) where left-handedness has appeared make very vigorous efforts to repress a similar tendency in new members.

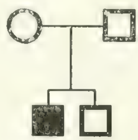

FIG. 10

Fig. 10. This case is interesting from the fact that the childship here is a pair of identical twins. Such twins (the result most probably of an independent development of each blastomere of the two-cell stage) may be partially 'mirror images' of each other, as appears here to be the case regarding the use of the hand and possibly its anatomical basis. However, an attempt to verify this hypothesis has failed. Four other pairs of identical twins (so adjudged on grounds of superficial similarity) are now known to me in all of which both members are right-handed.

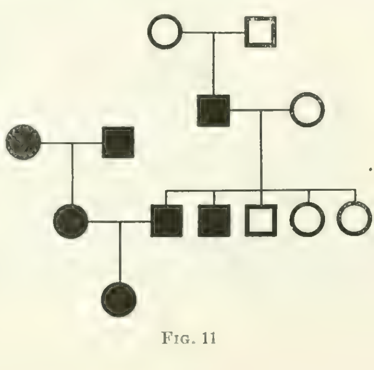

FIG. 11

Fig. 11. This case is most important in that the variation in question is very general. Three months ago I knew only the history up to the last generation represented. The child of this generation was too young to have shown any decided tendency one way or the other. Judging from the family histories, one would expect the mother to be homozygous and the father to be heterozygous (imperfect dominant). If this were so at least half of the children of the family should be left-handed. I have just received a letter from the father stating that the child is "decidedly left-handed." This case alone, I believe, justifies this limited collection of data. Families like this one, if fully recorded at some central office and followed during future years, may yield important information regarding the hereditary transmission of human characteristics in general.

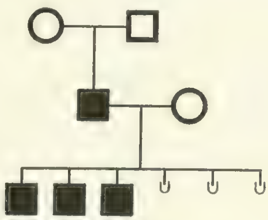

FIG. 12

Fig. 12. This case is interesting again in that the childship of six is equally divided between affected and unaffected individuals.

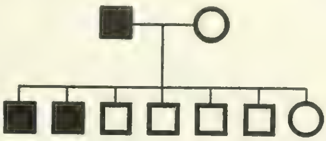

FIG. 13

Fig. 13. The history of this case was kindly supplied to me by Dr. W. Thalhimer (instructor in pathology). It gives additional proof for the hypothesis that in left-handed individuals the controlling center is located in the right hemisphere (instead of the left as in right-handed persons).

In 1861 M. Broca definitely assigned the posterior part of the third frontal convolution of the left hemisphere as the seat of articulate speech. Accordingly ataxic aphasia ordinarily occurs in association with right-handed hemiplegia. This case shows that in a left-handed individual the reverse condition obtains. In brief,

this man (he has two left-handed children) developed a complete left-sided hemiplegia coincident with a complete motor aphasia. Dr. Thalhimer's notes are in part as follows: "The correlation of left hemiplegia—indicating a right-sided cerebral lesion and aphasia—suggested a contralateral displacement of Broca's motor speech area, and this suggested a contralateral displacement of normal right-sided functions, and it was immediately discovered on questioning the patient's family that he was and always had been left-handed."

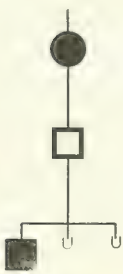

FIG. 14

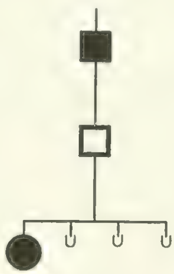

FIG. 15

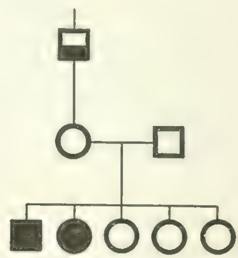

FIG. 16

Fig. 14, 15, and 16 again show a carrier in the second generation given.

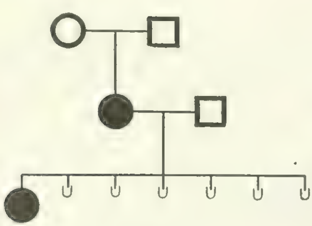

FIG. 17

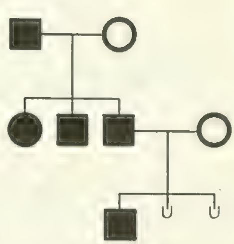

FIG. 18

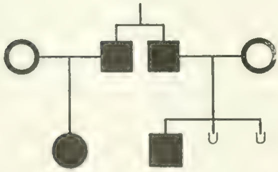

FIG. 19

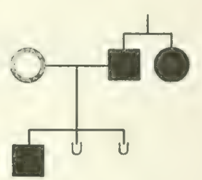

FIG. 20

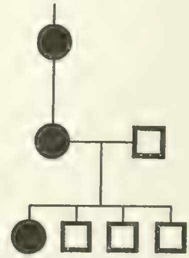

FIG. 21

Figs. 17, 18, 19, 20, and 21 again show direct transmission.

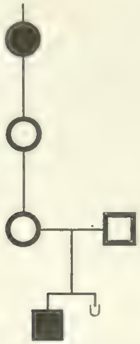

FIG. 22

Fig. 22 seems to show the influence of a great-grandmother carried "latent" in the direct line through two intermediate generations.

FIG. 23

Fig. 23 shows transmission of this character through four successive generations, the last represented by an only son.

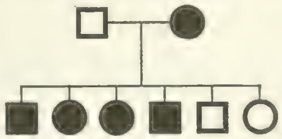

FIG. 24

Fig. 24 (colored) is interesting as a case where a left-handed mother and a right-handed father have four left-handed children in a family of six. This is the "John" family discussed in the Davenports' article on "Heredity of the Skin Pigmentation in Man."

STATEMENTS OF RESULTS

Among the left-handed university students, six (all inveterate) said they were the only persons so affected among all their connections. This testimony together with cases Nos. 9 and 4 leaves no doubt, I believe, that left-handedness often arises spontaneously. Case No. 9 again shows that such mutation or variation is hereditary.

Tabulating the childships of four or more individuals, the proportion of left-handedness to right-handedness is as 1:1½.

CASE NO.	●	■	○	□	☝	☝
2	—1	1	1	1	....	....
3	—1	2	2	....	....	....
5	—	1	....	6	....	....
7	—	2	2	....	....	....
9	< 1 1	1 1	1 2	1 1		....
11	—	2	2	1	....	....
12	—	3	....	....	3	....
13	—	2	1	3	....	....
Total	4	15	11	13	3	
		19		27		

The ratio of 16 left-handed students to a total body of 700 is about 2⅓ per cent.

Among the white pupils of the public school the proportion of left-handed to right-handed in affected families is as 39 to 79 or as 1 to 2. There is no evidence to support the opinion of some (*e.g.*, Weber) that left-handedness is more prevalent among women. The proportion of affected males to females is as 1 to 1. This school is represented by 604 males and 794 females (1,394). Thirty left-handed pupils here represent a ratio of about 2⅙ per cent, agreeing with the ratio for university students and Hyrtl's result for European peoples in general.

Summarizing the foregoing 49[5] white families in terms of heredity, we find the following modes of "transmission" represented in the frequency indicated:

[5] Including three families besides those of university students (16) and public school pupils (30).

	Number of Case
1. From grandmother to granddaughter	1
2. From grandmother to grandson	4
3. From grandfather to granddaughter	3
4. From grandfather to grandson	1
5. From mother to daughter	3
6. From mother to son	4
7. From father to daughter	2
8. From father to son	7

The following is a summary of the chief facts gathered from 29 colored childships: (a) In 5 cases either an uncle or an aunt is left-handed; (b) in 7 cases one parent is left-handed; (c) in 17 cases neither parent is left-handed; (d) proportion of left-handed individuals to right-handed is as 29 to 25; (e) the 29 school children included 15 males and 14 females; including the whole childship the proportion of affected males to affected females is as 17 to 18; including parents, uncles and aunts the proportion is 21 to 25; (f) the colored pupils included 287 males and 381 females (668); the 29 left handed pupils thus represent $4\frac{1}{3}$ per cent.

In the three sets of data the proportion of left-handed males to left-handed females is approximately equal. The proportion of left-handed colored children to right-handed (29 to 25) as shown in the above colored childships is probably not absolutely correct. It agrees well, however, with the high percentage ($4\frac{1}{3}$) of left-handed children when the entire school population is taken into account. I believe there is no escaping the conclusion that left-handedness is at least twice as frequent among colored as among white families. The less active repressive efforts counteracting the factor of imitation may probably be responsible for the high percentage among colored children. As explaining the above high ratio of left-handedness to right-handedness (29 to 25), I wish to emphazise the fact that among the 29 childships there are 7 cases of an only child, and this is left-handed (in 10 cases the entire childship was not given). This fact indicates either great infant mortality or a low birth rate. In fact, from what I have seen, I should say that both conditions more generally prevail; the second, contrary to the usual opinion, more especially.

It remains to explain briefly the method employed in collecting the facts regarding the pupils of the public school. The following questionaire was prepared and given to each teacher:

Determine the number of left-handed children in the Charlottesville city schools, and the degree of left-handedness in each case; i.e., what do left-handed children do with left hand and what with right hand.

Obtain answers to the following questions:

1. Which foot is used in kicking?
2. On which side is hair parted?
3. Which eye is stronger?
4. Comparative degree of intellectual capacity.
5. Which hand is preferentially used for gestures?
6. Which of the parents is left-handed?
7. Who among grandparents is left-handed?
8. How many children in family? And how many are left-handed in any degree? Give sex of each.
9. Who among the brothers and sisters of the parents of left-handed individuals are left-handed?
10. State additional matters of interest, and give total enrollment in school.

In the great majority of cases the left foot was used for kicking.

The returns regarding strength of eye showed an apparent equality respecting the number of right-eyed and left-eyed pupils. The simple nature of the tests employed, however, may render this result of doubtful value.

As regards the intellectual capacity of left-handed compared with right-handed pupils no significant difference could be deduced from the report.

I wish here to acknowledge my great indebtedness and to express sincere thanks to the teachers of the city schools and especially to the superintendent, Prof. J. G. Johnson, Ph.D., for the painstaking, thorough, and conscientious manner in which the investigations were conducted. Without this kindly coöperation the work would have been practically impossible.

INTERPRETATION AND CONCLUSION

The above detailed evidence is conclusive I believe, that left-handedness is hereditary. In what way or by what principle this inheritance acts remains obscure. From the 22 more complete pedigrees (of the 78 families studied), 6 childships (Nos. 2, 3, 9, 11, 12, and 24) can be selected of four or more individuals where the proportion of left-handed to right-handed individuals is approximately equal (*i.e.*, one less or one more than half in childships of more than four individuals). Tabulating these, the result shows an equal number of right-handed and left-handed individuals. The significance of this proportion lies in the fact that it need not necessarily have been even, *i.e.*, the more than half need not necessarily have counterbalanced the less than half of the childships. This ratio (not as significant as desirable because selected) suggests the Mendelian

ratio of the formula above, or the condition that obtains by crossing a heterozygote (*RL*) with a homozygote recessive (*LL*). The writer does not however delude himself—nor does he wish to leave the impression of attempting to mislead his readers in this matter—that left-handedness even appears (on the basis of the limited data presented) to follow Mendalian principles of inheritance. The sole step of prime importance he insists on at present is that the phenomenon of left-handedness is hereditary in some way.

The writer hopes that the inconclusiveness of this contribution on important points may be pardoned by reason of the preliminary character of the work; moreover, that the effort was justified because of the promise revealed, and the problems suggested in this field.

Superficially considered, it seems a far cry from the inheritance of coat-color to that of such a subtle characteristic as left-handedness. The gap here is perhaps only as wide as between this characteristic and such apparently still more subtle characteristics as virtue, justice, temperance, integrity, thrift, sagacity, etc.—characteristics of prime significance for the future trend of human history—and if the former gap can be bridged by hereditary formulæ, as seems possible, why not the latter? Once the principles which govern the transmission of these highly desirable human qualities are known, their "fixation" in continually increasing numbers of individuals seems a comparatively easy problem.

Facts regarding the conduct of the variation of left-handedness in heredity may reveal valuable information for the science of eugenics.

Again, if a characteristic like left-handedness rests upon an anatomical variation (a hypothesis well supported by various facts) perhaps many other characteristics have a similar basis and are amenable to experimental methods of research and simple methods of control. The study of left-handedness also finally shows (on Mendelian assumptions) the phenomenon of the "imperfection of dominance," as revealed in numerous cases of congenital and acquired ambidexterity. Moreover, the apparent imperfect dominance would here seem to be due proximately to a more or less complete structural and functional symmetry of the cerebral hemispheres.

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DISTRIBUTION OF IMPROVED SEED GRAIN IN KANSAS

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I do not think the presentation of a paper on this subject before this body of breeders and scientists needs any excuse or explanation. I observe, however, that much of the effort of this organization has been directed towards the propounding and demonstration of theories and facts related to the breeding and improvement of plants. This is necessary and valuable work, but the establishing of breeding laws and the production of improved and pedigreed seed or plants has little immediate value to agriculture, unless the improved plant or high-bred seed is propagated in large amount and distributed among the farmers for planting. The distribution of improved seed is just as important as the breeding, and this is a subject too often neglected by scientific breeders and by the experiment stations.

The writer's method of breeding crops aims to make the work count, not only scientifically and on paper, but toward producing the real thing, the improved seed, in quantities sufficient to distribute to the farmers, so that they may at once have the benefit secured from growing the better variety.

Some practical system must be adopted in every State by which high-bred or pedigreed seed may be grown and placed in the care of responsible farmers for further multiplication and distribution. The testing of varieties and the breeding of crops by the experiment station has little value unless the farmer secures the improved seed and grows it in large areas, to replace seed of average or inferior quality.

The method or methods of securing and distributing improved seed grain in Kansas may be briefly described as follows:

1. Many varieties of different kinds of standard crops are tested and compared at the State experiment stations, to prove their adaptation and productiveness, and the quality of their product.

2. The best producing varieties are improved and purified by careful hand selection in the field, and the seed is further improved by selection and grading.

3. Still further improvement and greater purity is secured by breeding the grain by the "ear-row" and "head-row" methods, by which pedigreed strains may be established.

4. The improved grain is grown in separate fields in larger areas to produce seed grain for distribution.

5. The seed grain tested by the experiment station is sold to the farmers, at their option or order, viz., the farmers voluntarily order and purchase the seed grain at the price fixed by the experiment station.

6. The seed grain which is offered for sale by the experiment station is advertised in different ways—through announcements in bulletins, by answering correspondence, by replies to inquiries published in farm papers and in local papers, and through the farmers' institutes, corn shows, and State farmers' meetings. During the last three years there has not been much need for advertising, since the demand for the "college-bred" seed grain has far exceeded the supply.

7. The improved seed grain has always been sold at a fair seed price, *at least double the market value of the grain.* The price varies somewhat, according to the improvement or breeding which the crop has received. Seed wheat has been sold at prices ranging from $1.40 to $2 per bushel. The selling price for seed corn has ranged from $1.50 to $5 per bushel, according to the breeding, variety, and grade of seed.

There has been very little complaint from purchasers regarding the price of seed grain. The better farmers are willing to pay a good price for good seed. In fact, many prefer that the experiment station should charge a high price for improved seed, because this allows them to grow the crops and continue the distribution of the seed at good prices, usually a little less than those charged by the experiment station.

The establishing of higher prices for well-bred seed grain than for scrub seed is placing the purebred seed business on the same plane as the purebred stock business, and there is just as good reason why a bushel of well-bred wheat which has been carefully and properly saved for seed should sell for double the market price as for a purebred calf or colt to sell for double or treble the value of a mixed breed or scrub.

8. Farmers who purchase seed from the experiment station are encouraged to keep the "college-bred" seed pure, grow it under favorable conditions, and save the crop again for seed, and thus become further distributors of the improved seed grain.

9. A record is kept by the experiment station of each sale of well-bred seed, including the name and address of the purchaser, the date of his order, and the value, grade, and amount of seed purchased.

The seed distribution work of the experiment station has continued now for six years. The larger part of the seed, however, has been

distributed during the last three seasons. More than 25,000 bushels of well-bred seed of standard farm crops have been sold and distributed by the experiment station, at Manhattan, and by the Ft. Hays branch experiment station, at Hays, including 15,000 bushels of seedwheat, 3,000 bushels of seed corn, 2,000 bushels of seed oats, barley, and emmer, 2,000 bushels of Kafir corn and broom corn, cane, and milo seed, and smaller quantities of flax, millet, cowpeas, and soy beans.

10. The experiment station gives some superintendence to the growing and saving of the crops for seed by farmers, by inspecting the fields when possible and by securing reports from each grower giving information regarding the variety, yield, purity, quality, and amount and price of seed grain which he will have for sale.

11. Published lists giving such data as named above have been prepared each fall and spring during the last three years, 1908, 1909, and 1910, and these lists are sent to those who inquire for seed grain. In this manner the experiment station has been able to assist in the continuing of the distribution of many thousands of bushels of "college-bred" seed wheat and seed corn.

The writer estimates that 25,000 bushels of Kharkof seed wheat were distributed by this means in 1909, and Prof. L. A. Fitz, who now has special charge of the inspection of wheat fields and the listing of wheat growers, reports the sale and distribution of 60,000 bushels in 1910. Seventy-two farmers reporting listed 30,000 bushels of "college-bred" seed wheat for sale in 1909. Growers were listed from forty counties in the State.

During the seed wheat campaign last summer 144 wheat fields were inspected by Professor Fitz and his assistants. Two thousand copies of list containing 162 names of farmers offering "college-bred" seed wheat for sale were distributed in answer to requests from inquirers. Each farmer on the seed-growers' list was requested to supply certain information regarding his crop and keep a record of sales. Fifty-four of the listed wheat growers reported as requested. Their total sales amounted to nearly 30,000 bushels. The quantities sold by individual growers ranged from 10 bushels to 3,200 bushels. The average yield per acre in 1910, secured by growers reporting, was 22 bushels. This was an average increase over other wheat of $5\frac{1}{2}$ bushels per acre, or $33\frac{1}{3}$ per cent.

Two million acres of winter wheat seeded in the fall of 1909, in Kansas, entirely winterkilled and were plowed up. The remaining 4,686,000 acres made an average yield of 12.8 bushels per acre.

Much of the wheat harvested had been severely damaged by winter-killing. The average yield per acre for the State in 1909 was 14.6 bushels. The average yield for the last ten years, 13.9 bushels.

Much well-bred seed corn has also been distributed by this method. Seventy growers reporting listed over 10,000 bushels for sale in the spring of 1910, and reports indicate that the supply did not equal the demand.

For the purpose of securing and giving information on the subject of crop improvement and seed distribution, the experiment station has published a number of bulletins, circulars, blank forms, lists of growers, etc., copies of which may be secured by those interested.

12. Another plan which is being developed proposes to distribute improved seed grain by means of the county demonstration farms, which are now being established in many counties in Kansas. The law passed in 1909 allows for the establishment of demonstration farms in connection with the county poor farm of each county at the option of the county commissioners and in coöperation with the agricultural college. Seventeen demonstration farms have already been organized. The plan is to plant only improved or "college-bred" seed on these farms, save the crop for seed, and sell the surplus seed grain to the farmers in the county who may wish to purchase it at a price somewhat in advance of the ordinary seed price.

Several of these farms have already been established and a few have raised a crop of purebred seed wheat which was sold for seed last fall. On the county farm in Barton County, Kansas, last year there was a field of 11 acres of Kharkof wheat that produced an average of 45 bushels per acre, and every bushel was sold for seed to the farmers of the county at $1.50 per bushel. From five or six demonstration farms in eastern Kansas last year the sales of well-bred seed corn aggregated over 1,200 bushels and sold at an average price of $1.50 per bushel. On these several farms the following crops have been grown for the production of seed to sell: Kharkof wheat, Kherson and Red Texas oats, and improved strains of Kafir corn and cane and several varieties of well-bred seed corn. No variety has been planted on any demonstration farm which did not have the approval of the professor of agronomy of the agricultural college.

This method promises to be a very successful means of growing and distributing improved seed grain which will be especially adapted to local climatic and soil conditions.

When the writer took charge of the agronomy work at the Kansas State Agricultural College in the fall of 1902, there was not a bushel

of well-bred seed grain of any kind on the experiment station farm. The work of variety testing and crop improvement by seed selection was begun in 1903. As soon as it was shown that certain varieties were superior, or as soon as pure seed of some of the better producing varieties could be produced, these varieties were grown on larger areas and the surplus seed was sold and distributed among the farmers of Kansas.

A small amount of seed grain was distributed in 1904 and 1905, being mainly seed wheat from seed which was tested for several years in the State, at the United States Government Coöperative Experiment Station, at McPherson. In 1906, a larger amount of good seed grain was distributed, including some well-bred seed corn. The breeding of corn by the "ear-row" method was begun in 1903 and 1904, and the breeding of wheat and other grains by the "head-row" method was begun in 1906 and 1907. The improved varieties produced by seed selection and breeding, especially of corn, Kafir corn, and cane, were propagated as rapidly as possible, and the amount of well-bred seed grain distributed has steadily increased each year.

During the interval of five or six years since this seed distribution work began, the agronomy department of the agricultural college[1] has distributed over 5,000 bushels of seed wheat, nearly 3,000 bushels of seed corn, more than 2,000 bushels of seed oats, barley, and emmer, nearly 2,000 bushels of cane, Kafir corn, milo maize, and broom corn seed, and smaller quantities of seed of other crops, such as flax, millet, cowpeas and soy beans. The total quantity of well-bred seed distributed amounts to more than 12,000 bushels.

Similar work has been carried on at the Ft. Hays branch experiment station. More than 10,000 bushels of improved seed wheat has been distributed by that station. Over 6,000 bushels of pure Kharkof seed wheat was distributed last fall, 1910. The Ft. Hays station has also sold and distributed several hundred bushels of good seed of corn, Kafir, and cane, and a thousand bushels or more of pure seed of oats, barley, and durum spring wheat, or in total an amount nearly equal to that distributed by the agronomy department.

This seed grain has been sold largely in small quantities as stated above; hence, the improved seed has been distributed widely to thousands of farmers in every part of the State and to a considerable number of farmers in other States. By the method described—

[1] The writer had charge of this department from December 1, 1902, to June 1, 1910, when he was transferred to Ft. Hays branch experiment station, as superintendent.

encouraging the farmers to save their crops for seed and sell the surplus seed large quantities of "college-bred" seed, amounting to several thousand bushels of seed corn and many thousand bushels of seed wheat, having been distributed and planted.

The wheat area of Kansas averages about 7 million acres annually. The writer estimates that 2 million acres of Kharkof wheat—the variety most widely distributed by the experiment station—was planted in the State last fall, 1910. The comparative tests at the experiment station and the reports of many growers prove that under equal conditions, where hard red winter wheat is adapted, the Kharkof will yield from 25 to 30 per cent more grain per acre than ordinary scrub wheat, which is still planted on a large area. The Kansas wheat crop in 1910 was so severely injured by winterkilling in parts of the State that the acre yield or the whole State was reduced below the average, and the result of planting improved seed was not apparent. The possible increase in our yield of wheat in 1911, due to the distribution of better seed, may be estimated at not less than 6 million bushels.

In the distribution of improved seed corn an important agency has assisted which I have neglected to mention. This is the "boys' corn contests," work which is carried on under the college extension department. Thousands of boys have secured improved seed corn by taking part in this contest, and the variety of corn by proving its superior quality has usually remained on the farm, the farmers often purchasing more seed of the same variety, in order to plant larger fields.

The instruction at the agricultural college in the regular courses and through the boys' and men's short courses, through the farmers' institutes, experiment station bulletins, and the agricultural press, has also given efficient aid in the progress of seed improvement.

The average acre yield of corn in Kansas for the last ten years has been about 21 bushels. The corn crop of 1910 was severely injured in parts of the State by very hot weather and drouth in July and by chinch bugs, and the acre yield was below the average, only 19 bushels. In 1909, the acre yield was 20 bushels, but 200 growers reported an average yield from "college-bred" seed of 36 bushels per acre.

The writer estimates that from one-third to one-half the total area of the State, or about 3 million acres, will be planted with well-bred seed corn next spring, and it is not extravagant to estimate an average increase in yield, due to the better seed, of 5 bushels per acre on this area, or a possible increase in the Kansas corn crop in 1911 of 15

million bushels. This is not speculation, but a careful estimate deduced from facts.

Improved seed distribution and the education on crop improvement which has accompanied it have produced another very important result, viz., the farmers have become awakened not only to the necessity of improving the crops, but to the necessity of improving the soil fertility and practicing better farming methods. The distribution of improved seed grain in Kansas, therefore, marks the beginning of a new agricultural area which will be noted for high crop yields and great agricultural prosperity.

Kansas has already made a national reputation through her improved seed distribution; in fact, this reputation is world-wide. It actually appears that the work done in Kansas along this line is noted and talked about and written about more outside of the State than within the State. Inquiries and orders for seed wheat and seed corn have come to the experiment station from all over the United States and from several foreign countries, including Australia, South Africa, and several of the countries of Europe and South America. A year ago the Kansas Agricultural Experiment Station shipped 50 bushels of improved Turkey Red wheat to the Transvaal government of South Africa. A bushel of seed of each of ten varieties of Kansas-grown corn was shipped to the government experiment station, at Brisband, Queensland, Australia, in the spring of 1910. Exchanges of seed wheat and other seed grain have been made with several experiment stations in Russia. In 1908 the experiment station in southern Alberta, Canada, ordered 60 bushels of our Kharkof and improved Turkey Red wheat, which was sent with charges of $2 per bushel, rather expensive seed wheat, but one of the best investments that Alberta ever made. This well-bred Kansas wheat yielded over 50 bushels per acre, or 9 bushels more than the best Alberta red varieties in 1909, on the experiment station farm at Lethbridge. I am informed that thousands of bushels of wheat from this seed have been distributed and planted by Alberta farmers.

The writer has recently been invited to deliver addresses on this subject before the National Corn Show, and American Breeders Association, and at the meeting of the Council of American Grain Exchanges. It is evident that this work in Kansas has created great interest and is attracting much attention in other States and other countries.

The improvement of crops by breeding and selection is primarily the work of the experiment station, and the experiment station should

be the source and first distributor of well-bred seed. But the amount of seed supplied by the experiment station is necessarily small, and the farmers who secure the better seed must grow it carefully, keep it pure, and continue the distribution, in order that great and rapid benefit may result from the work of the experiment station. The permanent improvement of crops rests with the farmers who shall continue the growing and distribution of improved seed.

AN EXPERIMENT IN FUR-SEAL CONSERVATION

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For a quarter of a century the "fur-seal question" has been one of the most serious problems with which the Department of State at Washington has had to deal. So long as the killing of seals was confined to the land on which they haul out during the breeding season there was no difficulty; but when certain people in British Columbia discovered that fur-seals could be killed in the open sea in sufficient numbers to make the business very profitable, then trouble began. This was in the early eighties. Pelagic sealing, as killing seals in the open sea is called, developed rapidly and it was only a few years until the very existence of the fur-seal herd as a commercial entity was seriously threatened.

The killing of seals on the islands can be, and always has been, carefully regulated by the Government. In the first place, it must be understood that the fur-seal is a polygamous animal, like sheep, cattle, or domestic poultry. While the sexes are born in approximately equal numbers, one male to every thirty to fifty females is adequate for breeding purposes. The surplus twenty-nine to forty-nine males are not needed and can be killed without in the least endangering the existence of the herd. There is no more reason for refraining from killing each year the surplus male seals than there would be in a stockman saving all the rams or roosters on the ranch. It has therefore been the policy of the Government never to kill any female seal but to kill each year the surplus young male or bachelor seals after reserving a sufficient number for breeding purposes.

In this way the Government was able to conserve the herd at high efficiency and at the same time permit the killing of about 100,000 young male seals each year, yielding an annual revenue to the Govern-

ment of about $317,500. That number now would yield a revenue of more than a million dollars annually.

But pelagic sealing is different. The pelagic seal hunter cannot distinguish between male and female seals or seals of different ages in the water; he would make no distinction if he could. Every and any fur-seal he sees is proper spoil for him; none is allowed to escape, whatever the sex or age. And experience and the records show that vastly the greater part of the pelagic catch each year consists of females. Every female seal killed in the open sea means not only her death and that of her unborn pup but also that of the pup which she leaves on the rookery when she goes out in the sea to feed. Every time a female seal is killed in the open sea a fur-seal pup is left to starve. Since pelagic sealing began some thirty years ago hundreds of thousands of pups have starved miserably on St. Paul and St. George.

The possibility of saving these motherless pups from starvation has often been considered, and several attempts have been made to induce them to take artificial food. All such attempts failed utterly. Every pup experimented with refused absolutely to take any kind of food, although various and ingenious devises were employed to induce or force them to do so. Similar attempts with older or adult seals also failed. They chafed under restraint or confinement, refused any and all kinds of food, and finally died of starvation.

Apocryphal tales may be heard on the Pribilof Islands of fur-seals having been tamed and living thereafter in the houses of the natives of the islands. In the early seventies the Alaska Commercial Company brought down from the islands two immature live fur-seals, their exact age not definitely known, and placed them in Woodward's Gardens at San Francisco, but they died of starvation after several months' incarceration, having eaten nothing during the interval. This experiment at Woodward's Gardens, and all other similar attempts, fixed the belief that fur-seals in captivity could not be induced to take food.

Recently, however, the experiment was again tried and with complete success. The effort had its inception in the desire of Dr. Fox, surgeon of the revenue cutter *Bear*, to ascertain whether the fur-seals are infected with ectoparasites. For this purpose a starving pup, whose mother had been killed by the pelagic pirates while feeding at sea, was given to the *Bear's* surgeon. After having been examined by Dr. Fox the half-starved little animal was turned over to Mr. Judson Thurber, the *Bear's* boatswain, who desired to attempt feeding the pup by artificial means. He was so far successful that he induced

it to eat dried fish from his hand, and kept it for three weeks, when it died in convulsions. Desiring to have the experiment carried further, two well-conditioned fur-seal pups, a male and a female, were obtained on Gorbatch rookery, St. Paul Island, and furnished to Boatswain Thurber on October 9, 1909. Mr. Thurber began his experiments by forcing condensed milk down the throat. On October 19 the female began eating solid food. Each of the pups experienced some difficulty in swallowing solid food, due, the boatswain thought, to the fact that the tongue was tied down too firmly by the membrane or frenum which binds it to the floor of the mouth. He was led to this opinion by observing that the female pup ate more easily after breaking the membrane loose. He then tore loose the frenum of the male's tongue, with the result that he, too, began to take food more freely.

In conducting the experiment Mr. Thurber showed no little skill and infinite patience. At first he would hold their mouths open, pour into them diluted evaporated cream mixed with small bits of fish, and then, holding the seal up by the head, shake the food down. In this way some of the food reached their stomachs and the seals got the taste of food. Then he would tie a small piece of fresh fish on the end of a string and tease the seal by dangling it in front of its nose until the seal snapped at it, when it would be poked down the throat and the string cut.

By the first week in November both seals were eating greedily. When the *Bear* arrived at San Diego late in the fall, and the commanding officer, Capt. E. P. Bertholf, reported to Washington that the *Bear* had two fur-seal pups on board and in good condition, steps were at once taken by the Hon. George M. Bowers, Commissioner of Fisheries, to have them brought to Washington. All necessary details were soon arranged and Boatswain Thurber arrived in Washington January 11, 1910, with his precious pets. They were hurried from the express car to the Bureau of Fisheries, where they were received with great interest; for no one at Washington except the few fortunate ones who had visited the Pribilof Islands had ever seen a live fur-seal. They were at once placed in the large pool at the bureau after being photographed, measured and weighed. This pool contained fresh water, and the effect upon the seals was awaited with interest. If they showed any distress it was arranged to supply them with salt water. But the fresh water did not appear to worry them in the least, and they have been kept in it continuously to the present time.

Although somewhat restless at first they soon quieted down and appeared perfectly at home. They are fed regularly twice a day on

fresh fish, which they take eagerly, each eating from 5 to 8 pounds daily. When they were first weighed (January 20, 1910), the male weighed 28 pounds and the female 19½. Since then they have been weighed regularly on the twentieth of each month. On October 20 they weighed 46½ and 34½ pounds, respectively. This is a gain of 66 per cent for the male and 77 per cent for the female in nine months. Whether this is a normal growth no one really knows, for never before were any accurate observations made to determine just how much a fur-seal six months or fifteen months old ought to weigh. But those who are familiar with seal life on the Pribilof Islands say that these two pups appear fully as large and fine in every way as those of the same age on the rookeries.

Not only have these two pups been kept in fresh water, but the water in the summer was much warmer than any Alaska fur-seal was ever before called on to endure. In July the temperature of the water ran as high as 83° F., and the average for that month was 80°. But this high temperature apparently produced no evil results; indeed, the seals during July were not only as playful and active as usual, but they actually ate more during that month than in any other.

They have proved the most interesting pets that have ever been kept in the aquarium at the Bureau of Fisheries. They are the most expert swimmers imaginable. Their favorite pastime is to swim rapidly around the large pool in which they are kept, sometimes as rapidly as the most rapidly flying bird, often jumping like porpoises and splashing water on unsuspecting visitors. They circle about the pool, always turning to the right with the hands of the clock. Immediately after feeding they begin scratching and rubbing themselves, a sort of massage which doubtless aids digestion.

These fur-seal pups have now been kept in captivity more than a year. They have been kept in fresh water more than nine months. They are now sixteen months old and appear to be in excellent condition. The experiment has so far proved eminently satisfactory. It has demonstrated a number of very important facts. In the first place it has shown that fur-seal pups can be taught to take food when offered them by man. It also shows that they can be kept in captivity and carried long distances on vessels or railroad trains without any special difficulty, that they will live and thrive in fresh water, that a salt-water environment is not essential, and that they can live without any apparent discomfort in water of a much higher temperature than that of their natural habitat.

The success of this experiment also suggests a number of interesting possibilities. May it not be possible to save the hundreds or thousands of pups whose mothers are killed by the pelagic sea pirates every year? To do this it would be necessary to feed the pups only until the herd leaves the islands late in the fall. After they have once been taught to take solid food it would seem that they might be permitted to leave the islands with the rest of the pups and that their chances of survival in the sea would be quite as good as any.

The supplying of fur-seals to public aquariums and zoölogical parks is another possibility which seems entirely practicable. The possibility of establishing a colony of fur-seals in some fresh-water lake is also suggested. The essential features would seem to be a lake with an adequate supply of fish, which does not freeze over entirely in winter, and in which the seals would be fully protected.

But most interesting and important of all is the possibility of establishing colonies of fur-seals on our North Atlantic Coast. If the Canadian government could establish a fur-seal colony or rookery somewhere on her east coast, the pelagic sealing question would speedily be solved; for it would seem that Great Britain would at once join the United States and the other maritime nations in an international game law or agreement by which the high seas beyond the three-mile zone would become a place of refuge for all marine mammals such as fur-seals, sea-lions, walruses and whales. This would not only stop pelagic sealing, but it would be the most effective step ever taken for the preservation of these rapidly disappearing animals. It is true that the difficulties in the way of establishing the fur-seal in the Atlantic are very great, but I think they can be met.

NOTE—Since this article was written the experiment has been carried still further. The two seals are still alive and apparently in excellent condition at the present date,—September 9, 1911. On August 20, 1911, they weighed 63 and 41.5 pounds respectively.

[Presented by Committee on Fur Bearing Animals.]

EDITORIALS

SIZE OF FARMS AND FARM FAMILIES

The New York Agricultural College at Cornell has recently issued a bulletin based on an agricultural survey of four townships in the New York county of Tomkins, in which the college is located. This report, by Prof. G. F. Warren and others, shows that in order to assure a reasonable family income the family farm should be rather large. The deductions from the statistics collected seem to indicate that the best size is somewhere between 160 acres and 200 acres for Tomkins County, where the average value of the land is low.

Merely from the standpoint of economic production as the result of a sufficient division of labor, profitable employment of labor, and the utilization of labor-saving machinery, a farm large enough to employ two or three workers was found to be the most profitable.

On farms up to about 100 acres in area the cost of production per acre and per worker is relatively too great. The crop yields on these smaller farms are not sufficiently greater to overcome a larger cost per acre of man labor, horse labor, machinery, and incidental expenses. A farm owner, to make an income beyond his own labor wage, must have acreage enough to use two, three and four-horse teams, and the machinery adapted to those teams, rather than only one or two horses. The larger farm makes it possible for the farmer to use the labor of his sons, or of one or more hired men, so as to make some profit beyond the market value of their labor.

The fact that a relatively small part of the farmers can make good incomes by intensively cultivating a small fruit or vegetable farm has led many people to believe that our family farms are generally too large to serve best the interests either of the farmers or of those who purchase the farmers' products. It must be remembered that the bulk of the American farm products is composed of grains and live stock, and that these are and must be produced in a broad way under conditions of general farming.

On the other hand, the assumption that the results obtained in the course of this agricultural survey indicate that our farming must eventually go the way of the businesses of transportation, of manufacture, and even of merchandising, and be organized under large companies, is not justified. In farming, where the home and the business are a unit, there is another most important interest at

stake, aside from profits per acre and per worker, or the abundance and cheapness of products supplied to consumers in our cities.

The larger farm product is the farm people. The plan of one farm and three hired men is good for the farmer and his family, but not good for the average of the four families; and if we extend this centralization so as to have one farmer and nineteen hired men, the farm profits are centered in a still smaller number of farmers. Thus a larger school district, such as a consolidated rural school district of 20, 30, or 40 square miles, might have ten farm homes and 190 homes of hired men. Two hundred families thus situated would not make so strong a community as under the present plan of 100 farmers on family farms assisted by their fifty sons and fifty hired men, making two men to the farm. It should be remembered that most of the hired men under family farm conditions are farmers' sons working their way up to become landowners.

This plan gives two men per farm. It avoids on the one hand the too small farm plan which France brought about by enforced legal division of farm estates, and on the other hand the too large estate which in England is made possible by the law permitting primogeniture and the entailment of estates, and keeping the entire large estate intact for the eldest son.

The larger public policy will be best served when the eugenics side of country life is fully appreciated. If the two-man farm plan will produce the greatest number of good citizens, will conduce to the production of the strongest country people, and will result in the largest measure of happiness to the sum of the people in the open country, means should be discovered not merely to preserve but to highly develop country life under that plan.

This bulletin from Cornell, however, adds to the conviction that farming must follow all other lines of business and be organized. There must be either radical centralization of the ownership of land or the less radical but fully as effective individual ownership with fullest coöperation to attend to the general business of the farm. The interests of the race strongly favor the latter plan, provided there be really effective coöperative organization. Fortunately plans are being formulated in thousands of communities which promise solutions, and which may lead to a remarkable development of our already unparalleled country life.

Colleges of agriculture; agricultural technological high schools; local schools made over in the interests of country life, departmental and college extension departments, and publishers of literature relat-

ing to farming and farm home making are developing adequate means to take to all farm people the rapidly accumulating stores of knowledge relating to the farm and the farm home and are working out a wonderfully productive scientific technique of farming and country living.

What promises to be the most important single element in all of this development is the consolidated rural school, serving a large community or district. Six or eight one-room rural school districts, covering a scope of 20 to 36 square miles, are consolidated into one school large enough to have institutional organization. Fifteen of these schools in the average county bring vocational as well as general education within driving distance of all farm youth. This institution unifies the education for country life and it also recenters nearly all other country life interests. It promises to lead a technologically educated people into general economic, social and educational coöperation.

In this community attention will come to be paid to the values of good heredity, and the community will doubtless come to look upon each farm home as an institution in which the public, the State, and the race is interested as the source of strong people.

The two-man farm of 160 acres is in danger, and with it America's plan of producing the most just and beautiful country life in the world. The danger is that publicists, educators, and even the farmers themselves look primarily at the business side of farming.

Our investigators into farm management need to look very specifically at the economic side of farm organization, but they need also as clearly to investigate the social, racial and eugenic interests of life in the open country.

THE FIELD OF EUGENICS

Man will one day know himself better and will use more care to cultivate assiduously the consciousness that he is a higher being with most wonderful possibilities. Eugenics will ere long drive home to the human race the fact that its worst blood should be reproduced but slowly, if at all, and that it is a sacred duty of the best blood to multiply itself and people the earth.

In a newly colonized country, its forming race is hybridized in the most complex manner; but no matter how complicated, it is possible to establish the racial breeding values of each strain and family; and the probable value of each individual as a progenitor of generations of children can be at least roughly determined.

Society and even the church can then place a social pressure upon, and deter from reproduction, those likely to produce weak, diseased, or criminal offspring, and the state can even restrict child bearing on the part of those most deficient. Thus the major part of the weak fibers can be eliminated from the network of human descent.

But even more important is the fact that efficient blood can be encouraged by many agencies at the command of society to produce such numbers of children as they can well support and train. High public regard of unusually efficient families, probably more than anything else, will be instrumental in stimulating pride of family among individuals, and in encouraging them to perpetuate their superior qualities in larger families of children.

Society is now rather assisting families of weaker heredity to multiply, through various forms of otherwise most beneficent charities. How to lessen the effects of thus breeding the race downward, and how to favor the production of progeny whose blood improves the network of descent of the race, are still difficult problems. That the human race will highly develop its plants, its domestic animals, and its household pets, and permanently neglect itself does not seem plausible.

The methods at the command of eugenics are narrower than those employed in plant or animal breeding. In case of the apple we can produce ten thousand seedling trees, test each tree as to quantity and quality of fruit, and discard all but the one best, and then by grafting, budding, or other processes we can soon so multiply the one plant that it will fill all the orchards of the region to which it is adapted. In breeding cattle, swine, or poultry, individuals which are inferior or are susceptible to disease can be discarded. In cereals, live stock, or fruit, two or more strains, each possessing desirable characters, can be hybridized, thus engrafting upon the new stock the good qualities of both parents. And even in hybrid plants the selection of progeny can be so restrictive that only that one in hundreds or in thousands, or in tens of thousands, which comes nearest the desired type, need be selected.

In the human family there can be no such sweeping discarding of the unfit. But the superlative importance to the species of multiplying the good blood and thus building up better race stocks makes even a narrow range of possible improvements a matter of vital concern. Family genealogies are needed which, not as the present comparatively worthless ones, merely record names and relationships, but which make a note of certain characteristics of each individual.

When racial, family, and individual values shall have become matters of pedigree record, and eugenics shall have passed the stage of ignorance and prudishness, the race will more rapidly slough off its weak branches, while the more virile and useful stocks will build up the tree of life. From generation to generation, eugenics, improved physical environment, education, religion, and the inherent impulse in the human soul to aspire after better things will relegate to inactivity the weaker and baser characters.

The improvement through heredity may at first be painfully slow. The improvement from education and from an ever-growing altruism will for some time be more rapid. But the race will experience its greatest improvement and attain its greatest ultimate physical and intellectual development through eugenics, because heredity is basal, and every point gained in heredity serves as a better basis upon which to build all other improving processes.

WORLD'S FOOD REQUIREMENTS MET BY BREEDING BETTER TYPES

No one who studies world economics can doubt that a permanent world competition for food at high prices has begun. Increase in the world's population and increase in the purchasing power per capita of all thrifty peoples will not only sustain prices for farm products, but will require rapid and large increases in the total product. In two or three generations we shall need to feed 180,000,000 people in the United States where we now feed 90,000,000. Since the present population consumes $7,500,000,000 worth of farm products annually, the requirements then will be for products worth $15,000,000,000.

Assume that the 10,000,000 farmers in the entire country sixty years hence will annually apply fertilizers worth one dollar per acre to 500,000,000 acres, at a cost of $500,000,000, and that the result would be $1,000,000,000 worth of added farm products, then the profit in this case would be $500,000,000, or 100 per cent.

Assume also that the federal and state governments, through their departments of agriculture and experiment stations, and the farmers and breeders of the country shall have expended in creative plant and animal breeding two dollars per farm, or $20,000,000. If this should increase the product one dollar per acre on one hundred acres on each of 10,000,000 farms, it would amount to $1,000,000,000, with a new profit of $980,000,000, or 4,900 per cent.

Further, we may roughly estimate that we shall during that time so add to our cultivated area as to increase our annual product by $2,000,000,000. It is fair to estimate also that by better crop rotation schemes, better tillage methods, and better methods of managing our live stock we can add yet another $2,000,000,000. The total addition thus provided would be $6,000,000,000—still one and a half billions worth of product short of the additional $7,500,000,000 needed.

It is entirely possible that the farmer and breeder under scientific direction, by spending somewhat more than $20,000,000 for creative breeding might produce the other one and one half billions worth of product needed. It is, indeed, probable that 25 per cent, instead of only 10 per cent, might be added to the yield of farm products by breeding and applying this to the increased acreage under the improved conditions assumed. Thus, approximately $2,500,000,000 of additional products annually would be possible through improvements in heredity.

In other words, it does not seem improbable that when our product is worth $15,000,000,000 fully $2,500,000,000 worth of the added product may be due to plant and animal forms producing an average of 25 per cent more than those now in use. Because of the relatively small outlay it requires, breeding is especially effective not only in increasing the quantity of agricultural products but also in reducing the cost of production. Let us give the heredity of the mutating plant and animal an important place as one of the world's great forces beside the fertility of the soil and beside the power which we utilize from water, coal, wood, oil and wind.

PRESERVE THE RED MAN'S HEREDITY

A movement has been inaugurated under the auspices of American Indians of pure and mixed breeding to foster and preserve the remnants of the Indian race. This effort has much in it which is to be highly commended. It will engender racial pride, will foster individual ambition, and will lead to tribal and family emulation. Eugenists will see in this movement a plan for preserving certain characteristics of this race, that they may not be lost from our sources of good blood. This new organization can help to preserve a race of purebred Indians, as the Arabian Horse Association in America is collecting and preserving pure blood of that class of horses. And as the Arab horses have served most effectively as the whole or partial

basis of some of our most useful families and breeds of horses, such as the saddle horse and the Morgan horse, so the blood of the Indian may perhaps be used as part of the basis of virile families of men.

No one need feel offended at this illustration from the domain of live stock. In fact, no small part of the plans which will be used in eugenic records designed either to preserve the heredity of races of men or to aid in their genetic improvement is being wrought out in the record systems of plant and animal breeding. And we have further illustrations in the animal world of the need of preserving the aboriginal races and species. A most notable example is the American bison or buffalo. A few men have saved it from extinction, and there is much promise that breeds of cattalo, made by hybridizing the buffalo and cattle, may have a large field of usefulness. At present small herds of these hybrid cattaloes indicate that breeds combining beef and fur production may be developed for regions requiring great endurance of cold winters, as in our northern mountain regions and in Alaska. The demonstration seems complete that robes finer, more uniform throughout, and more valuable than the buffalo robes of pioneer times can be produced by the scientific creation of breeds of hybrid cattaloes.

In some of the tribes of the American Indians are characteristics which may have uses in the future American type. The pigment in the skin may enable the crossbred between the pale face and the red man to thrive better in the hot regions of our own country or in the tropics. His endurance gained in the chase may help in making up the future race of men suited to many of the strenuous tasks which future civilization will, more even than now, impose upon both men and women. A strain of his stoicism and ability to live far away from his fellows may peculiarly fit him for the work of the forest guard in our great public forest reservations.

As a pure race, or perchance in mixture with our mountaineer whites, he may become our future mountain inhabitant, adapted at once to the rugged life of the isolated mountain home and to the service of forest workers in our great areas of forests under scientific public or private management. He may be peculiarly adapted to life on the great semiarid plains, where science has begun to guide the production of breeds of live stock for the production of meat, wool, and horses under conditions existing in the great short-grass country.

But why restrict him? Either in his purity of blood or in mixed races the American Indian may take up very many functions of life. The Indian needs only to see his racial problem, to study his genetic

destiny in the light of modern science, to find the niches, large or small, into which he may fit, and then redirect his energies to meet the new problems before him.

In numerous regions the amalgamation of the Indian and white races has so far developed that much of the psychological repugnance to the mixture of racial blood has been broken down. A study of the vigor, ability, and general character of these people of mixed blood of the third and later generation hybrids should be made by trained eugenists. Those characters which act definitely as Mendelian units should be known; also, those recombinations of unit characters which make for weakness, and those which give strength and both individual and genetic efficiency. Those persons who have begun the organization to preserve and build up the remnant of our ancient Indian blood may have in mind only education, political rights, and other environmental conditions. But the eugenic side of the movement is worthy of equal consideration.

A system of number names for which the Indian office could supply very much material would place this race in a position of advantage as compared with other races. By recording the individual value both in a single numerical statement and in unit character detail there would soon be records from which the genetic value of individuals and families may be deduced. Many of the methods of tabulating, averaging, and otherwise determining the genetic values of the respective individuals and families have already been practically wrought out in the science of breeding plants and animals.

Even a larger vision for the Indians to realize is that ere long all races shall have been brought under the scrutiny of genetic science. Then the Indian character as a whole and each racial unit character will be in competition under methods more or less aided by statistical records of performance with the characters of other races. It is a good guess that the Indian blood will not be near the foot of racial values and that families both of purebred Indians and of those mixed with white and other blood will find permanent places under a system of genetic records which will discredit all the weakest families if not the weakest races.

NEWS AND NOTES

REPORT ON CONFERENCE OF RESEARCH COMMITTEES OF THE EUGENICS SECTION

On May 2 and 3 a conference of the research committees of the Eugenics Section of the American Breeders Association was held at the Monson State Hospital, Palmer, Mass., under the presidency of Dr. W. N. Bullard, chairman of the Committee on Inheritance in Epilepsy. About twenty persons were in attendance, including the following members of the committees of the Eugenics Section: H. H. Goddard, E. E. Southard, F. A. Woods, Everett Flood, W. M. Carmalt. After introductory remarks by the presiding officer, brief statements were made by Dr. Carmalt, of New Haven, who stated that the law in Connecticut relating to sterilization had not yet been put in practice in a single case in that State. Dr. Ross, who has just been appointed superintendent of a new institution for epileptics in Mansfield, Conn., spoke briefly of the plans of that institution. Mr. H. H. Laughlin, superintendent of the Eugenics Record Office, moved the appointment of a committee to study the result of the experiment in sterilization made by various States. The chairman named as members of this committee Dr. Mitchell, superintendent of the Danver State Hospital, chairman, Mr. Laughlin, secretary, and Messrs. W. M. Carmalt, Bleecker Van Wagenen, and Everett Flood. Dr. Rosanoff, of Kings Park State Hospital, representing Miss Orr and himself, read a paper on "Further Studies on Inheritance in Insanity," confirming and extending the results of the paper by Miss Cannon and Dr. Rosanoff, recently published in the *Journal of Nervous and Mental Diseases*, showing that idiopathic forms follow Mendel's law.

Dr. Flood summarized the recent report of the commission appointed by the governor of Massachusetts to investigate the question of the increase of criminals, mental defectives and degenerates. The report had to be drawn up in a short time and the commission had small funds for its assistance. They reached a general conclusion that there is no evidence of an increase in the number of these defective classes in Massachusetts. They make a series of recommendations. Dr. E. E. Southard read the report of the Committee on Heredity in Insanity, of which Dr. Adolf Meyer is chairman. Dr. C. B. Davenport presented a paper on the relation between geographical isolation and consanguineous marriage, calling attention to the fact

that many islands off the New England coast showed much intermarriage of relatives and an unusually large proportion of cases of recessive characteristics in the population. Similarly, the valleys in mountainous or hilly countries and other communities isolated by their distance from railways and means of communication from the outer world are regions of consanguineous marriage. Dr. A. H. Estabrook, field worker of the Eugenics Record Office, gave an account of the degeneracy in a valley in eastern New York State. Here over two-thirds of the population of over 600 persons are mentally defective. There is a large proportion of consanguineous marriages. Dr. David F. Weeks, superintendent of New Jersey State Institution for Epileptics, reported on the methods that are being used to standardize methods of charting human pedigrees. These are set forth in Bulletin No. 2 of the Eugenics Record Office. This was discussed by Dr. H. H. Goddard, Mr. E. R. Johnstone, superintendent of the Vineland Training School, and others. Mr. H. H. Laughlin, superintendent of the Eugenics Record Office, gave a report on its work that is published elsewhere in this *Magazine*. Dr. C. G. McGaffin, pathologist, Taunton State Hospital, Taunton, Mass., presented three pedigree charts:

(a) The C. family: Four generations had been traced with a fair degree of accuracy and the living members of three generations had been interviewed. The first generation showed two cases of maniac-depressive insanity; the second, five cases of maniac-depressive, one of paranoia, and one of imbecility; the third, no active mental symptoms, but there was a prostitute, a vagrant, and one with a criminal record among its members; the fourth consists of children who up to the present have shown no mental symptoms, although two are considered weak-minded.

(b) The W. family: This family shows cases of Huntingdon's chorea in five generations, also some insane members.

(c) The H. family: A chart showing over 1,000 individuals with insanity in six generations. This chart was worked out entirely from the genealogical record of this family, a volume unique in its careful tabulation of biologic record.

Miss Florence Danielson, a field worker of the Eugenics Record Office assigned to the Monson State Hospital, gave an account of one of the families that she has studied most extensively, showing a high incidence of feeble-mindedness, alcoholism, and sex immorality in certain rural communities of southwestern and western Massachusetts. Dr. F. A. Woods read a paper on separating heredity from environ-

ment, published in a later *Magazine*. Mr. L. B. Alford, research officer and pathologist of the Monson State Hospital, spoke on inheritance in epilepsy after the Brown-Sequard method and demonstrated with guinea pigs.—C. B. Davenport, *Secretary*.

THE HEURTIN FAMILY OF VERTOU

As an example of a defective germ plasm perpetuating itself persistently and with disastrous results the Heurtin family of Vertou,

Three of the Heurtin Family.

Stanislas congenitally deaf and nearly blind. Marie and Martha congenitally blind-deaf

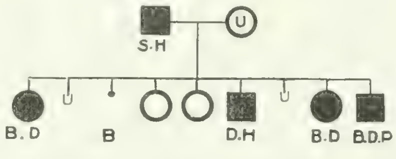
France, furnishes instructive material for the eugenist. A Breton tun maker, Stanislas Aristide Heurtin, in 1884 contracted marriage with his second cousin four years his junior. He is a sufferer from a spinal (marrow) disease and also from hemeralopia which is described as an abnormal condition of the eyes in which the sense of vision is impaired by artificial light (the reverse may also be the case, when it is day-blindness). Nine children resulted from this marriage, as follows:

1. Marie, born April 13, 1885; born blind-deaf.
2. Lucien, born February 8, 1887; died at the age of 21 days.
3. Eugenie, born December 11, 1887; born blind; died August 5, 1899.
4. Elisa, born December 24, 1891; in possession of all senses, normal.
5. Adelaide, born July 29, 1894; in possession of all senses, normal.
6. Stanislas, born December 21, 1896; born deaf and "hemeralope."
7. Germaine, born January 3, 1899; died March 12, 1902.
8. Marthe, born July 23, 1902; born blind-deaf.
9. Germaine Andre, born November 22, 1906; born blind-deaf and paralyzed in the limbs; died January 20, 1908.

Thus, summarizing, of nine children only two were normal and capable of enjoying all faculties, three were born blind-deaf, one deaf and "hemeralope," one blind, and four died young.

The close blood relationship of the parents may perhaps have been a partial cause of the infirmity of their progeny, but the greater probability is that the father's infirmities were responsible.

The heredity of the family is shown strikingly in the chart below.



HEREDITY OF THE HEURTIN FAMILY.

U Defect if any, not ascertainable.	B Blind.
S Spinal disease.	D Deaf.
H Hemeralopia.	P Paralyzed (in limbs).

The amount of physical defectiveness carried in the blood of this family is appalling. But there is no doubt of the correctness of the data, which are vouched for by M. A. Constantin, director of the Institution de la Persagotière at Nantes, France, who has favored the Volta Bureau, Washington, with the statement. Mr. F. K. Noyes, editor of the *Volta Review*, kindly loaned the copyrighted photograph shown above.

IMPORTANCE OF RAISING THE SECOND GENERATION OF CROSSES

This *Magazine* is read by some who can not find time to keep abreast of the theoretical side of the experimental work in breeding which has developed so rapidly of late. It may therefore be of use to notice the importance of getting the second generation from a cross. The breeder should not reject the results of a cross when the individuals of the first generation do not show anything which he thinks worth preserving. As Bateson states in his excellent account of breeding work (Mendel's Principles of Heredity, 1909), some amount of money has been lost through this procedure. It is difficult for most people to refrain from judging an animal or plant merely by its exterior. But the breeder at least must judge by performance and not by looks. He who rejects a crossbred plant or animal because its outward appearance does not satisfy him is throwing away a purse because it looks shabby, without opening it to see what money it may contain.

A good example of this has come under my notice. The velvet bean, which is an important forage crop in Florida, and bears short velvety pods, was crossed with a new and promising bean from the Philippines, the Lyon bean, which has long pods covered with down. All the plants grown from the crossed seed bore long pods clothed with fine hairs which got loose and penetrated the skin so as to cause irritation. In the words of the gardener, they "were covered with hot fuzz that nearly drove one crazy." If this cross had been raised during the last century, it is probable that all the stinging plants would have been burnt. But the knowledge already gained by experiment led to the saving and hulling of these pods. Their seeds grew into vines that bore pods, on some plants all stinging, on others all downy, on others all velvety, and on others nearly smooth. Differences as to early or late ripening, amounts of healthy pods, proportions of scattered seeds, long or short pods, sizes of seeds, colors of seeds, sizes of bunches, numbers of seeds in pods, etc., are visible, and enable selections of forage plants to be made from the progeny of those seemingly useless stinging plants of the first generation.—JOHN BELLING, *Gainesville, Fla.*

PROGRESS REPORT FROM GENETICS CONFERENCE TO BE HELD IN PARIS

The organisation committee of the fourth International Conference of Genetics assembled on June 14 under the presidency of Dr. Viger. Mons. Philippe de Vilmorin, secretary of the committee, told the assembled members what had been done to prepare for the conference. He had received 130 adherents of which three are honorary members. The sum received in subscriptions up to that date amounted to 2300 francs. The rest was expected to be received in the course of July. Not counting the names of the principal French biologists who are members of the committee, the following foreigners have subscribed: Baur, Giesenhagen, Goldschmidt Pfitzer, Poll, etc. (Germany); Agar, Bateson, Darbishire, Gregory, Miss Durham, Hartog, Laxton, Lynch, Nettleship, Paton, Punnett, Miss Saunders, Staples-Browne, Sutton, Miss Wheldale, etc. (England); Bradley (Australia); Fruwirth, Strakosch, Tschermak, etc. (Austria); W. and C. Saunders, (Canada); Johannsen (Denmark); Balls (Egypt); Davenport, Hays, Howard, Swingle, Tower, etc. (United States); Hagedoorn, Houwink, Lotsy, Norduijn (Holland); Leake (India); Strampeli (Italy); Nilssonehle (Sweden); Chodat (Switzerland); Boris de Fedtschenko (Russia); Arechavaleta (Uruguay), etc.

A NEW ZEALAND ESTIMATE OF THE AMERICAN BREEDERS ASSOCIATION

The January, 1911, number of the *Journal of the Department of Agriculture of New Zealand* contains an article—one of a series on plant breeding—by Prof. A. H. Cockayne (A.B.A.), in which he makes mention of the work of the American Breeders Association in the following language:

One of the most powerful organizations devoted to the furtherance of breeding is that of the American Breeders Association, an institution which is doing an immense amount of good in securing uniformity of work, formulating methods for special investigation, and, in general, advancing the science of breeding into one of the most essential and valuable of all the sciences connected with agriculture. It is split up into a large number of com mittees, consisting of the ablest investigators in America. The plant-breeding phase of the work is being given full prominence, as it is recognized that plant improvement is one of the primal factors governing the agriculture of the present day. Its membership is already over eight hundred strong, and is constantly increasing. During the past, great prominence has been given in all countries to animal breeding, and the results achieved have led to the establishment of many organizations dealing with the subject; but the American Breeders Association recognizes that plant breeding should go hand-in-hand with animal

breeding, and the influence of this association is likely to give a great impetus to this work in America, where even now plant-breeding is assuming important proportions. Every experiment station—and there are one or more in every State—devotes a portion of its funds to plant improvement, and much of the money of the "Adams Act" is to be used in this connection. The crying need of the present-day farmer is to increase the returns from the area he cultivates, and to enable him to do this the aid of the plant breeder must be invoked. The American Breeders Association, in bringing before public notice the urgent necessity of more breeding work, especially with plants, conducted in a truly scientific manner, and pursued with a definite aim, will be conducive of much good.

NOTE FROM NORWAY

Dr. H. H. Gran, professor of the botanical laboratory of the University of Christiania, Norway, and member of the American Breeders Association writes that the Norway Horticultural Society, of which, by the way, he is president, has systematically begun work in plant breeding.

ACKNOWLEDGMENT

The editor of the *Magazine* is indebted for permission to reproduce the likeness of Benjamin Tomkins, Jr., to Mr. T. F. B. Sotham. The plate is from Mr. William Sotham's work on "The History of Hereford Cattle."

PUBLICATIONS RECEIVED

SPINELESS CACTUS. Luther Burbank, Santa Rosa, Cal. 32 pp. Illustrated. A history and description of varieties of Opuntia (spineless cactus).

EINFUEHRUNG IN DIE EXPERIMENTELLE VERERBUNGSLEHRE. Prof. Dr. Erwin Baur. 1911. 293 pp., 80 text figures, 9 colored plates. Publishers, Gebrueder Borntraeger, Berlin.

DIE DEUTSCHE LANDWIRTSCHAFTLICHE PFLANZENZUCHT. Dr. P. Hillmann, manager of the seed-growing division of the German Agricultural Association. Prepared under authority of the organization. 1910. 663 pp.; 346 illustrations and 1 colored plate. Publishers, Deutsche Landwirtschafts Gesellschaft, Berlin.

CONFIDENCES. Talks with a young girl concerning herself. By Edith B. Lowry, M.D. Forbes and Company, Chicago. 1911. 94 pp.

TRUTHS. Talks with a boy concerning himself. Same author and publisher. 1911. 95 pp.

These are two companion books, and what is said below applies to both. They are designed to be placed, and in the reviewer's opinion ought to be placed, in the hands of every boy and girl of from ten to

fourteen years of age. And as a matter of fact thousands of adults might profitably read these books.

"Confidences" and "Truths" tell in simple conversational style of the mystery of reproduction and of the care of the body. The language is chaste, direct, and personal, and it is all said so charmingly, delicately, and winningly that the author is sure to gain the confidence of her young reader. The penalties which nature inflicts upon those who disobey either knowingly or ignorantly are referred to incidentally and as a warning, and not in a way likely to frighten.

Dr. Lowry has rendered parents and all in charge of young lives a real service. It is doubtful if wise instruction such as contained in these books can be imparted as well by any grown person not having special training. Many parents find themselves tongue-tied in conversations on this subject with their children. But that parents should place upon strangers, playmates, or servants the terrible responsibility of imparting this knowledge to their children is criminal. We have come to realize that silence and evasion are stupid and criminal and have been the cause of untold harm. There is springing up a healthy sentiment in favor of meeting parental responsibility with becoming sense and intelligence, and of giving timely and sensible instruction to youths concerning sex life and the elemental biological processes. Dr. Lowry has hit upon a most happy way of telling her story. "Confidences," written for girls, is if anything written in brighter vein than the other book. These booklets should be the counsellor of every boy and girl.

THE SOCIAL DIRECTION OF HUMAN EVOLUTION, AN OUTLINE OF THE SCIENCE OF EUGENICS. William E. Kellicott, Professor of Biology, Goucher College. 249 pp., 29 illustrations. D. Appleton and Company. 1911.

Incorporating the essence of lectures delivered before the students of Oberlin College, this book is written in plain, easily understood English, and is a welcome addition to the number of works treating on eugenics in popular language. Presentation of the subject in this manner from authoritative sources will be the urgent need of the eugenics propaganda for many years to come. Decades will probably have to pass before the racial conscience will be awakened to the realization of the enormities of the crimes committed under the cloak of custom, tradition and prudery, against the integrity of the race. Books almost without number, written in all languages, for all classes of people, will be needed to perform this important educational function. The book is optimistic, though not for a moment losing sight of the difficulties and obstacles in the way of eugenic reforms.

The outline does not pretend to present the results of research work or of original investigations on eugenics by the author. On the contrary, he draws upon the work of those who have done fundamental research in this new science and shows the bearing of their discoveries on economic and social conditions.

In intention the book is suggestive, giving in large, boldly-drawn but necessarily fragmentary outlines a view of the entire field of human heredity. The best written and perhaps the most interesting part of the book is the second half, in which is proposed and discussed a eugenics program.

Some criticism may be offered upon the author's lack of uniformity in the use of symbols to illustrate heredity charts. The appearance and readability of the book would have been considerably improved by using the symbols employed by the Eugenics Section of the American Breeders Association. The uniform and general use by writers and publicists of these symbols would soon lead to recognition and knowledge of their meaning among the general public and even on the part of the casual reader. The sooner this can be accomplished the better are the prospects of eugenic teachings sinking into the public mind.

The Law of Sex Determination and its Practical Application. Laura A. Calhoun. 254 pp., 2 illustrations. The Eugenics Publishing Company, New York City. 1910.

This sizable work is another contribution to the very numerous theories of sex determination or production of sex at will. It is apparent that the author makes a serious attempt to treat the subject from a scientific point of view. But the major premise of the dissertation is not based upon conclusions obtained by scientific methods. It lacks experimental evidence and the support of statistical data. In fact, the author seems to realize this, to judge from the admissions, direct or implied, that she has not given the theory the necessary experimental corroboration or tests. To cite an instance; after explaining her view of the effect under her law of sex determination, in case of partial castration of domestic animals, she suggests: "This could be tested by a breeder of animals, and if proved to be the case would be of great value."

Part of the book is devoted to a review of the status of the study of the heredity of sex, origin of sex, relation of the cell to sex, and theories of sex determination which have from time to time been put forward. The author is aware of the fact that the number of these

theories runs pretty well into the hundreds. There are other hundreds of "theories" and "recipes," notable chiefly for their grotesqueness, which are practiced by farmers and breeders for controlling sex of offspring of domestic animals.

The book is reflective but hardly conclusive. It seems that the author would need a very much larger number of cases to prove the correctness of her theory, and to submit a physiological and cytological rationale of the processes involved.

A new and heretofore apparently unobserved phenomenon is described and termed "telegyny." A considerably larger basis of fact than is submitted will be required to command a serious consideration of this theory from genetists in their present skeptical state of mind. Telegyny, in brief, is a peculiar influence exerted by the "previous female."

If this book shall bring us nearer to the solution of the difficult problem of sex control it will establish for itself a most enviable place.

A STUDY OF THE IMPROVEMENT OF CITRUS FRUITS THROUGH BUD SELECTION. A. D. Shamel. Circular No. 77, Bureau of Plant Industry, U. S. Department of Agriculture. 19 pp., 25 illustrations. 1911.

NATIONAL VITALITY, ITS WASTES AND CONSERVATION. Irving Fisher. Senate Doc. No. 419, 61st Congress, 2d Session. Presented by Mr. Owen. 122 pp. An extract from Report of the National Conservation Commission. 1910.

THE STUDY OF HUMAN HEREDITY. Bulletin No. 2, Eugenics Record Office. Charles B. Davenport, H. H. Laughlin, David F. Weeks, M.D., E. R. Johnstone, Henry H. Goddard. Cold Spring Harbor, N. Y. 17 pp., 4 illustrations. A guide for field workers and others interested in collection of heredity data. Being an exposition of the methods in use at the Eugenics Record Office, the New Jersey State Village for Epileptics, the Training School for Backward and Feeble-minded Children at Vineland, N. J.

Several pages are devoted to symbols, abbreviations, and heredity charts, illustrating their proper construction and the use of symbols and abbreviations. This paper will appear in full in the bound Annual Report of the American Breeders Association.

ASSOCIATION MATTERS

CHANGES OF ADDRESS

Members who may have occasion to change their address during the year are requested to advise the Secretary, giving their old as well as new addresses, so that the mailing list of the Association may be kept correct and up to date.

PORTRAITS OF SCIENTISTS AND BREEDERS

Separate prints of the portraits of scientists and breeders which have appeared in the *Magazine* during 1910 may be obtained from the Secretary's office at ten cents each postpaid. These portraits are printed in sepia tone on sepia paper and are especially suitable, when framed, for adorning the walls of offices, class-rooms, and dens.

TO JOG THE MEMORY

Members of the American Breeders Association who may have received their due bills of membership for this year are respectfully requested to make remittances promptly. Each lot of renewal notices sent out by the Secretary's office entails upon the Association considerable expense for postage and clerk hire. Kindly coöperate in saving this outlay.

CHANGE OF PLAN WITH REGARD TO MAGAZINE

The publications of the American Breeders Association, viz., the *Magazine* and Annual Report, are the results of the coöperation of its active members. They have given these enterprises admirable support from their inception, contributing always freely at no small sacrifice of time and effort.

During 1910 the plan was followed of publishing all papers suitable for magazine matter in the *Magazine* and republishing these, together with the more strictly scientific papers, in the Annual Report. This resulted, even with exercise of the greatest discrimination, in making the 1910 volume of the *Magazine* rather more technical than was desirable in a magazine planned along popular lines. To meet this criticism it was decided hereafter to publish in the *Magazine* only popular articles, reserving the strictly scientific ones for the Annual Report No. VII and not republishing in the latter any of the articles

appearing in the *Magazine*. In doing this the editors have assumed the task of printing fully one-half more matter than had been published by the Association in any one year, and have to a certain extent imposed upon the members the task of contributing more largely than formerly.

It is to be hoped that members will continue to be animated by the spirit of coöperation, and contributions from members and from non-members in the way of articles, news, notes, or photographs will be welcome at all times.

TEN THOUSAND NEW MEMBERS WANTED

Here is one suggestion how to get those 10,000 new members. You surely have among your friends and acquaintances a number who are interested in some phase of breeding or in eugenics. If so, will you write at least ten a letter, or speak to them personally, inviting them to join the American Breeders Association?

Explain that they should join; that through their membership they will help in the promotion of a large and vital movement; that every person interested in things that live and grow, and every person possessing pride of family and race should read the *American Breeders Magazine* and catch the inspiration of its optimistic world philosophy, and the faith in the possibilities of the human race; that to be identified with a movement of such vast import and possibilities confers distinction.

Write the Secretary of the Association advising him of the name and address of the persons you are corresponding or conferring with, in order that your efforts may be supported from this end of the line and that we may send circulars and sample copies of the *Magazine* to your nominees. The Association needs earnest, loyal, personal work on the part of each one of its members. Let us get those ten thousand members within the next twelve months. This is only about two hundred from each State and should be easy of accomplishment.

THE AMERICAN BREEDERS ASSOCIATION TO ITS PARENT[1]

The Association of American Agricultural Colleges and Experiment Stations, Greetings:

By unanimous vote of the American Breeders Association at its sixth annual meeting, its Council was directed to extend greetings

[1] Read before the meeting of the Association of American Agricultural Colleges and Experiment Stations by Prof. W. M. Hays, Secretary of the American Breeders Association, on Nov. 17, 1910.

to its parent organization, the Association of American Agricultural Colleges and Experiment Stations. I have the honor, therefore, in the name of the Council of the American Breeders Association, to express to you, our parent organization, our feeling of high regard and our profound gratitude for your service to all interested in the objects of the new organization.

In 1899 the idea occurred to those attending the Hybridizers' Conference in London, under the auspices of the Royal Horticultural Society, that there should be in America an association of breeders, which should include both those interested in plants and those interested in animals. This suggestion was placed before Secretary Wilson, who suggested that a committee of the Association of American Agricultural Colleges and Experiment Stations would be the best auspices under which to organize such an association. Following this suggestion, a promotion committee was appointed at the annual meeting of the Association of American Agricultural Colleges and Experiment Stations at New Haven, Conn., in 1900.

Under the call issued by the promotion committee appointed for that purpose by the Association of American Agricultural Colleges and Experiment Stations, a meeting was held during the last days of December, 1903, in St. Louis, Mo., at which the American Breeders Association was formed. Since that time six annual meetings have been held, at Champaign, Ill., Columbus, Ohio, Lincoln, Nebr., Washington, D. C., Columbia, Mo., and Omaha, Nebr. The seventh annual meeting has been called to meet with the National Corn Exposition at Columbus, Ohio, February 1, 2 and 3, 1911.

The American Breeders Association has successfully carried out the purpose of your organization committee in bringing together both the scientists and the practical breeders interested in both plant breeding and animal breeding. As originally formed, besides general officers, there was a Section of Plant Breeding and a Section of Animal Breeding. By a nearly unanimous vote by mail of the membership in 1910 the Constitution of the Association was changed, adding a third section relating to heredity in man, called the Eugenics Section.

The reports of the annual meetings already published and now in preparation have the credit in America and abroad of containing the best collection extant of authentic knowledge relating to heredity and breeding. During 1910, the Association established a magazine under the name *American Breeders Magazine*. Up to this time the membership was confined largely to scientists and technical breeders.

but with the organization of a magazine the effort is being made to build up a large membership of practical plant breeders and animal breeders and of people who have a general interest in heredity in man.

The work of the Association is largely done through committees, nearly fifty in number. These committees carry the main responsibility of securing from the members of the Association and others the addresses and papers presented at the annual meeting. These papers, together with special articles, editorials, and news items secured by the Secretary or prepared in his office, make up the subject matter of the *Magazine*. As yet a large part of the material of the *Magazine* is reprinted in the Annual Report. Members are requested to use the individual numbers of the *Magazine* in securing new members, depending upon the bound Annual Report for their files of the scientific articles.

The \$2 annual membership fee from about one thousand members has paid the necessary expenses for stationery and for printing the Annual Report. The increasing membership which comes with the establishment of the *Magazine* promises to pay expenses and to gradually build up the *Magazine*. The Association is at present on a basis of something over one thousand members and 150 life memberships. The \$20 fee for life membership has given a permanent fund of about \$3,000. The management of the Association has always kept the expenses within its income and at present there is a small surplus in the current expense fund which is now being used in a campaign for greatly enlarging the membership.

The American Breeders Association is proud to come back to its parent Association with a substantial report of progress. It is fair to say that the new Association has greatly increased the interest in the scientific study of heredity, in the improvement of our several billion dollars' worth of plant products, and in the better scientific breeding of our domestic animals. It has assumed the delicate yet important task of leadership in the discussion of heredity of the human family. The officers of the Section of Eugenics, the committees on the different phases of heredity in man, and the editorial officers of the *Magazine* and Annual Report have adopted the policy of instituting scientific investigation rather than entering campaigns for promoting any existing theories regarding the improvement of heredity in man. Under the direction of this section, private funds have been supplied so that a number of people are devoting their entire time to investigations in different phases of eugenics. An article in No. 3

of Vol. 1 of the *Magazine* by Dr. Goddard of New Jersey on "Heredity of Feeble-Mindedness" illustrates the fact that we have an open field for investigation of very great importance in human heredity.

It is believed that the Association is greatly stimulating the work of breeding in departments of agriculture and state experiment stations and by private institutions and individuals. Annually larger and larger expenditures of money and time are being devoted to working out the facts and methods needed by breeders of plants and animals, and larger and larger sums are being placed at the disposal of those who under public or private auspices create new varieties, breeds, and strains with new values.

The promotion committee which called the first meeting of the American Breeders Association was composed of the following-named gentlemen: Prof. W. M. Hays, University of Minnesota, St. Anthony Park, Minn., chairman; Director L. H. Bailey, Cornell University, Ithaca, N. Y.; Prof. Thomas F. Hunt, Cornell University, Ithaca, N. Y.; Dr. Herbert J. Webber, U. S. Department of Agriculture, Washington, D. C., and Dean Charles F. Curtiss, Iowa Agricultural College, Ames, Iowa.

The Association and its Council have assumed the work delegated to the promotion committee. It is now suggested that this statement be received as the final report of the promotion committee and that it be discharged.

The new Association comes to the old, not only to express its deep gratitude, but also to express the most hearty good will and the wish for the broadest coöperation in the future.

Sincerely and with gratitude,

W. M. HAYS, *Secretary for the Council.*
C. F. CURTISS, *Chairman Animal Section.*
H. J. WEBBER, *Chairman Plant Section.*

RECEPTION OF A. B. A. ANNUAL REPORT NO. VI

Volume VI far surpasses the high quality of previous A. B. A.'s. We are all pleased with it.—ARTHUR W. GILBERT, *Cornell University.*

The American Breeders Association Report Volume VI is just to hand and we think it fine.—B. F. KAUPP, *State Agricultural College, Denver, Colo.*

You are to be congratulated on the wonderful progress made by this Association.—JAMES E. RICE, *New York State College of Agriculture.*

I want to congratulate you on the splendid work that has been done during the past year. I have gone pretty thoroughly into the report and am more

than pleased.—E. R. JOHNSTON, *New Jersey Training School for Feeble-Minded Children.*

Am very much pleased to note the commendable progress made by our Association, and hope it may continue to flourish and widen its scope of usefulness.—C. N. KEENEY, *LeRoy, N. Y.*

We think Volume VI the neatest, nicest printing and binding of the entire series.—Q. I. SIMPSON, *Palmer, Ill.*

The proceedings came along in due time and are intensely interesting.—HERBERT QUICK, *Editor Farm and Fireside, Madison, Wis.*

Courtesy of H. D. Ayer, Animal Photographer, St. Anthony Park, Minn.

IMPORTED HAMPSHIRE DOWN EWES.

THE AMERICAN BREEDERS MAGAZINE

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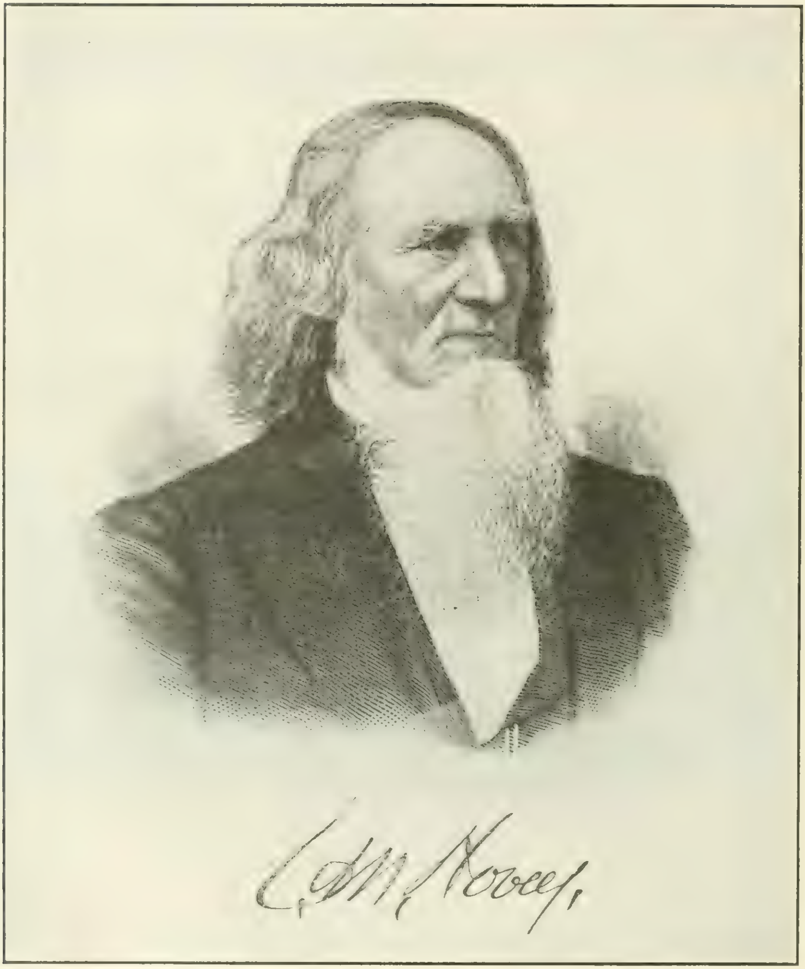
C. M. Hovey.

THE AMERICAN BREEDERS MAGAZINE

"Seed is the beginning of all wealth."—W. R. Smith.

Vol. II | Third Quarter, 1911 | No. 3

CHARLES MASON HOVEY, 1810-1887

The domestication of plants and animals was man's first decided interference with nature's usually automatic regulation of her affairs —an assertion of man's personality, and a proclamation of man's mastership.

One of the remarkable incidents connected with the fact of the domestication of plants is that apparently unpromising or almost negligible characters often caught the breeder's eye. He developed them to an unusual degree, first by cultivation, then by selection and breeding. The unobtrusive wild strawberry is a case in point, and the man with the eye of genius who saw possibilities in the edible, small red berry, and who had in his mind the method and in his hands the skill to bring about a most wonderful change in shape, size, and in the shipping and keeping quality of the strawberry was Charles Mason Hovey.

Long perhaps after minor incidents of his active and useful career shall be forgotten Mr. Hovey, who was born in Cambridge, Mass., in 1810, will be known as the "father of the American strawberry." He bred and propagated a large number of varieties of fruits and flowers, shrubs and vines, some of these of great merit. The *Thuja hoveyi*, a form of arbor vitæ, has a place in the heart of every lover of evergreens. But his largest offering, his *chef d'œuvre*, was a strawberry which made possible the development of all our present American commercial varieties.

Up to Hovey's time the common wild strawberry and its cultivated descendants furnished the tables direct from the garden, but of commercial varieties there were none.

The origin of Hovey's basic variety cannot be intelligently discussed without going somewhat into the history of the domestication of the strawberry. And fortunately Dean Bailey of Cornell has discovered the clue to this history in his study of the garden varieties of the strawberry. Previous to the time when Bailey assigned a definite, specific place to our cultivated strawberry and recognized

it as *Fragaria chiloensis*, it was treated as a sort of stepchild by botanists and had no place or name in particular which would indicate either its origin or botanical position.

The fact that scientific study had to disclose its real origin after it had been in cultivation for almost two hundred and fifty years adds strength to the often repeated statement that the origin and domestication of most of our cultivated plants are veiled in doubt and mystery.

Fragaria chiloensis, a strawberry plant originating in Chili but known to be common to western North and South America, had been brought to Europe about 1712. Forty years of cultivation and use had developed nothing of outstanding value. Then, somewhere, suddenly a mutation, possibly a hybrid, which was an improvement on this parent, seems to have arisen and found distribution as the "Pine Strawberry" from its flavor resembling that of the pineapple. Hovey crossed the native American strawberry with imported plants of this "Pine" variety and obtained a large number of crosses from which he fruited two varieties of especial promise which he named Hovey and Boston Pine. The Hovey was the first pistillate strawberry placed before the American public. It gave strawberry breeding a wonderful impetus and hybridizers began to put out new varieties.

And as early as 1830 he had a list of 30 strawberries of his own origination, all springing from the Hovey, and in fact practically all commercial varieties sprung from this one original parent variety. In 1836 the Hovey was distributed commercially and for thirty years in succession this variety took first premium over all other varieties at the exhibitions of the Massachusetts State Horticultural Society. Among all his varieties the originator held it in high esteem.

Hovey was versatile, resourceful, and possessed of apparently inexhaustible enthusiasm. He was successful as author, editor, plant breeder, nurseryman, and merchant. He contributed voluminously to horticultural literature, and in 1835 established a journal under the name of *American Gardener's Magazine*, which was subsequently changed to *Hovey's Magazine of Horticulture*, which continued during thirty-four years. He entered upon the publication of a pretentious and elaborate illustrated work, named "Fruits of America," of which two volumes were published.

Mr. Hovey was elected president of the Massachusetts Horticultural Society and vigorously promoted the interests of that institution. During his term of office its membership was increased from

500 to 1,000. His efforts were largely responsible for the erection of a beautiful building for the society's use. He was an inveterate collector of varieties. On his experimental grounds he had at one time 1,000 varieties of pears, 100 of apples, and 50 of plums, and at one time he showed 200 varieties of camellias.

THE SUPPOSED INFERIORITY OF FIRST AND SECOND BORN MEMBERS OF FAMILIES: STATISTICAL FALLACIES

T. B. MacCauley
Montreal, Canada

There is a general impression that while the study of eugenics may be interesting it can be of but little practical value owing to numerous and obvious difficulties in applying to the improvement of the human race the principles and methods which can be used in animal and plant breeding. Students of the science, while frankly recognizing this difficulty, have endeavored, nevertheless, to make their investigations as practical and helpful as possible. It has been thought by some that a foothold for practical work has been found in the supposed fact of the inferiority of the early born members of families, which certain authorities have claimed to have discovered and proved. If later born children are, on the average, superior to their elder brothers and sisters, then all influences which tend to increase the size of families have not merely a numerical effect on the population, but also an effect in preventing degeneration and improving the quality of the race. Several other important conclusions have also been drawn from this supposed fact. It is therefore desirable to investigate carefully the foundations on which the theory is based. Is it really a fact that early born children are, as groups, usually inferior to the later born of the same families? Let us examine some of the statistics which are relied upon as proof.

I have before me Dr. Karl Pearson's "First Study of the Statistics of Pulmonary Tuberculosis." It contains an analysis of the records of 381 families, with 2,164 members, each family having one member in the Crossley Sanatorium.

Tuberculous families, numbers of each class of sibling.

Order of siblings.	Number of cases.	Order of siblings.	Number of cases.
1	381	12	15
2	366	13	9
3	332	14	6
4	289	15	2
5	247	16	1
6	185	17	1
7	126	18	1
8	86	19	1
9	57	20	1
10	35	21	1
11	21	22	1

The tuberculous patients from these families were distributed as follows:

Tuberculous patients

Number of siblings.	Number of cases observed.	Number of cases calculated.	Per cent observed of calculated.	Number of siblings.	Number of cases observed.	Number of cases calculated.	Per cent observed of calculated.
1	113	67.1	168.4	8	9	15.1	59.6
2	79	64.4	122.6	9	3	10.0	30.0
3	41	58.5	70.0	10	3	6.2	48.4
4	52	50.9	102.1	11	3	3.7	
5	39	43.5	89.6	12	1	2.6	
6	18	32.6	55.2	13	1	1.6	56.6
7	18	22.2	81.1	14	1	1.1	
				above 14	0	1.6	

Dr. Pearson says:

If we consider the community as a whole, it will be built up of families in all stages of development. There will be some in which both eldest and youngest siblings have passed through the tuberculous zone, some in which the eldest have and the youngest have not, and some in which the eldest are in it and the youngest have not reached it. Each one in his lifetime passes through the danger zone, and we might expect, out of the totals that pass through, the same percentage would be attacked, whether they happen to be elder or younger siblings. In other words, if we take the Crossley Sanitarium population at a given date, we might expect that as far as position in family is concerned it would be drawn indifferently from all parts of the family.

Dr. Pearson accordingly finds the ratio of the 381 patients to the 2,164 members of the families to which they belonged, and, applying that ratio to the number of children of each order of birth, tells us that the resulting calculated numbers as given above are the numbers that should have been in the sanatorium if the liability to tuberculosis

were equally great in all members of each family, regardless of their order of birth. (See above table.) The actual numbers of inmates, it will be seen, are, among the early births, greatly in excess of the supposed normal numbers as calculated by Dr. Pearson, and are less than the numbers calculated for the later births.

Dr. Pearson further presents a diagram which vividly illustrates the supposed greater liability to tuberculosis of the early born, and the supposed comparative immunity of the later born, and adds: "It will be obvious on mere inspection of this table, or of the accompanying graph, that the excess of elder born, and defect of younger born, is most marked."

Dr. Pearson's conclusion is:

In general, whether we deal with all tuberculous stocks, or only with those having no parental history, the elder offspring, especially the first and second, appear subject to tuberculosis at a very much higher rate than the younger members. If this special incidence on the earlier born be found to be true for other forms of pathological heritage, we have a very serious factor of national deterioration introduced by the growing limitation of the family. It is further conceivable that any class which reproduces itself largely from the elder children, e.g., the peerage, as far as the father is concerned, would tend on the average to degenerate more rapidly. The substantiation in other cases of this pathological weighting of elder children, which appears true for the cases of tuberculosis and insanity, would be a eugenic fact of the greatest importance. The limitations of the family may not only be an evil, if it leads to a smaller relative output of the mentally and physically better stocks, but, even in the case of feebler stock, it may lead to a relatively larger proportion of the more affected individuals being added to the community.

In his pamphlet on "The Problem of Practical Eugenics," Dr. Pearson reproduces the diagram above mentioned, and adds other similar diagrams, showing the supposed greater liability to insanity, crime, albinism, among the earlier born. He adds:

If our observations are correct, and I believe them to be so, then the mental and physical condition of the first and second born members of a family is differentiated from that of later members. They are of a more nervous and less stable constitution. We find that the neurotic, the insane, the tuberculous, and the albinotic are more frequent among the elder born. Dr. Goring's results from criminality show the same law. The diagrams I put before you bring this out; you see in the tuberculous, the insane, and criminal stocks that the first few members are weighted. But the result of this law is remarkable. It means that if you reduce the size of the family, you will tend to decrease the relative proportion of the mentally and physically sound in the community. You will not upset this conclusion in the least, if, as I suspect, the extraordinarily able man, the genius, is also among the early born. For you will not lose him if you have a larger family, although you will lose the sounder members if you curtail it.

From these supposed facts the professor draws some very far-reaching conclusions, even claiming that they require a modification of the Mendelian theory. He says:

> It is difficult to reconcile this result with any simple Mendelian theory; it would seem necessary to combine such a theory with what amounts in result to a selective action on the gametes. I have already pointed out that such action would not only modify the Mendelian proportions, but also the parental co-relations. Further, this selective action would vary with the environment, *i.e.*, the changing constitution of the parents. Such direct action of the environment on the gametic cells is one which it would from the standpoint of national eugenics be of the greatest importance to study.

These arguments are certainly plausible, and the conclusions derived thereform are at least interesting. Before, however, we follow the professor in considering these embellishments or upper stories, so to speak, of the great structure which he has erected, let us examine the foundation stones more carefully. Unless the foundation be solid, the building collapses.

Let us consider first the statistics of tuberculosis. It is perfectly clear that the sanatorium contained larger proportionate numbers of early born patients than of later born of the 381 families. Does this, however, prove that early born children are more liable to the disease than later born? Not at all. Such a condition as that shown by Dr. Pearson's statistics was inevitable, and could have been foretold. Suppose, for instance, that of the 381 families included in the statistics, one consisted of fifteen children, the eldest twenty years of age, the youngest six months. The eldest had developed tuberculosis, and entered the sanatorium. All the fourteen younger brothers and sisters would be carefully tabulated and included in the numbers of tuberculous stocks of the later born. Because fewer of such later born and therefore young siblings, babies, perhaps, had become inmates of the sanatorium, we are asked to accept that fact as proof that later born children are superior to their elder brothers and sisters. It may be claimed that a family of fifteen is an extreme supposition, but the statistics before us include not only a family of fifteen children, but one of twenty-two. It is not wonderful, however, that the statistics also show that at least the youngest eight of that family (all of the eight being probably very young children some of them possibly infants) were not inmates of the sanatorium, there being no inmates belonging to any group beyond the fourteenth born.

Dr. Pearson tells us, however, that "while a certain number of families exist with young siblings in which the older alone are likely to suffer, there are others in which the older are dead, or past the danger zone, and in which only the younger are likely to suffer," and he makes the assumption, therefore, that there will be enough older members of families whom he considers to be dead or past a supposed "danger zone" to offset the younger siblings. Unless this assumption be substantiated, that there is a special danger zone, and enough members of the families beyond it to offset the younger siblings, the foundation of the whole theory and of all its developments is removed, and the entire structure collapses like a house of cards. When the vital importance of this assumption is thus realized, we would expect that some proof would have been produced in support of it, but there is nothing, absolutely nothing. The foundation is simply *assumed* to be there, and a great edifice is then endeavored to be built on it. To those who think the assumption is sound, we commend the following statistics from the report of the Registrar General of England and Wales, 1891–1900:

Annual mortality from phthisis per million living at various ages.

Age.	Mortality per million	Age.	Mortality per million.
0 to 4	413	35 to 44	2592
5 to 9	206	45 to 54	2362
10 to 14	368	55 to 64	1881
15 to 19	1144	65 to 74	1154
20 to 24	1730	75 and over	437
25 to 34	2135	All ages	1391

In the face of such figures it is difficult to see how the claim can be supported that the older members are "past the danger zone," and therefore not likely to become inmates of a sanatorium. Not until age 75 does the death rate from phthisis descend to the neighborhood of what it is below age 15. The professor claims that the mean age of onset of the disease is 29.1 for males and 25.3 for females. That, however, is merely another way of saying that at those average ages the patients *began* to be eligible for admission to the sanatorium. Patients may be admitted not merely at the onset of the disease, but probably at any time prior to death. Not merely, therefore, is the assumption which we are asked to accept entirely unproved, but in view of such statistics as the above, would appear to be entirely disproved.

To sum up: In Dr. Pearson's tables the inclusion of children and babies who are not yet old enough to be exposed to the dangers in question very clearly makes it inevitable that the groups of later born, to which these children belong, will show a more favorable percentage than the groups of early born, who are of necessity grown up. To draw any serious deductions from such statistics would on its face appear absurd. Dr. Pearson, however, contends that there are as many people dead, or who have passed the supposed danger zone, as there are children in the families not yet old enough to be exposed. This may be so, or may not be so. It is a tremendous assumption to make, and he does not bring an atom of proof in support of it. So far from being reasonable and credible, it appears to be in direct conflict with the statistics of the disease. Until the Doctor can show that there is a better foundation under his theories, he must not expect them to be taken seriously.

The diagrams produced in regard to insanity and crime are, as already mentioned, similar to that relating to tuberculosis. I have not before me the statistics upon which they are based, but there is little doubt that they have been prepared in precisely the same manner. If so, the inclusion of young children among the later births renders these results also valueless. The later born groups, which include a considerable number of children, naturally have not developed as large a proportion of insane persons and criminals as the older adult members of their families, but Dr. Pearson's contention that this proves that those later born individuals are to that extent superior to the older born is not even open for serious discussion. It cannot even be claimed that there is a danger zone in insanity and crime, such as was claimed for tuberculosis. The older siblings have in reality had just so much longer time to develop insanity or criminal propensities than the younger ones.

Apart altogether, however, from the effect of including in the statistics the undeveloped members of the families, another consideration, not, however, probably productive of as marked an effect on the statistics, would lead us to expect that the early born groups would show higher percentages of individuals lacking in robustness, or even given to crime. If one or other or both parents die, for example, of consumption at comparatively early ages, their average family will certainly be much smaller than in the case of couples neither of whom die prematurely. Parents of criminal or semi-criminal tendencies, moreover, may not remain together sufficiently long in the marriage state to have large families, though on the other hand some paupers

and others may have families over the average. The children of these small tuberculous or criminal families would of course all fall into the earlier born groups, and as a result of heredity we would expect somewhat larger percentages of weak or criminal children in those groups. That, however, in no way indicates that early born children are inferior to later born *of the same family.*

We now, however, come to another remarkable supposed fact which Dr. Pearson claims to have proved. He states that families containing tuberculous members are, on the average, larger than those of the total population. He makes a similar claim with regard to several other types of inferiority. Is this contention well founded, or is it like the one we have been previously discussing, a mere statistical fallacy which will not bear investigation?

I quote again from Dr. Pearson's study of the statistics of tuberculosis:

> The distribution of the 381 tuberculous families, which may be practically considered as completed, is as follows:

Size of family.	Number of families.	Size of family.	Number of families.
1	15	9	22
2	34	10	14
3	43	11	6
4	42	12	6
5	62	13	3
6	59	14	4
7	40	15	1
8	29	22	1
			Total 381

> Accordingly the mean family contains 5.80, and for the female pedigrees 5.59. Mr. Schuster finds the mean size of families containing at least one deaf mute to be from American statistics 6.08, and from English statistics for probably completed families 6.19.
>
> It would thus appear that fewer offspring are not born to stocks tainted with pulmonary tuberculosis.
>
> There is no reduced fertility in the case of tuberculosis; in fact their fertility is as great as that of any other class in the community.

The professor compares the result obtained as above with the average size of families in the community as a whole, and claims that these statistics show that "the families of the affected are larger, not smaller, than those of normals."

Do these figures really prove that the tuberculous families of the community are on the average as large as, or larger than those of normal

stocks? Most decidedly not. The mean family, as given, represents the mean for those particular 381 families, but it does not, and cannot, represent the average size of tuberculous families in the community as a whole. It is in fact impossible to ascertain the average size of a family in this manner. Statistics compiled in this way must always, and inevitably, overstate the average. Dr. Pearson treats these 381 families as though they were indifferently chosen from the tuberculous families of the community, but this is not so. Such a selection is one of children, not of marriages or of families, and the probability of any one marriage being represented in the sanatorium is in direct proportion to the number of living children in the family. Marriages with a large number of children are very likely to be included; marriages with but few children are correspondingly less likely; while childless marriages will not be represented at all. A marriage with ten children has ten times as great a chance of being included in the statistics as a marriage with but one child. A marriage with twenty-two children, like the one mentioned in Dr. Pearson's statistics, has twenty-two times the chance of being included that a marriage with but one child has, for there are twenty-two children who may develop tuberculosis as against one in the other case. The mean family derived from statistics so compiled clearly does not, and cannot, represent the average of the tuberculous families of the country, and to compare a result so found with the average size of a family in the community as a whole is simply to deceive ourselves.

Perhaps we will better appreciate the nature of these fallacies if we apply the same rules and reasoning by which they are produced to a supposititious case. Let us imagine a community which contains 1,000 families of one child each, and 1,000 other families with ten children each. These 11,000 children in the 2,000 families give an average family of course of exactly 5.5. To simplify the problem, let us assume that the 10,000 children of the families of ten are so evenly distributed that there are precisely the same number of first born children living at every age, from twenty to forty-four inclusive, and that the ages of the children of the same families are precisely two years apart. This is a purely artificial grouping, but its very simplicity will help us to understand better the principles involved. It is, of course, quite proper for us to ignore families of which no member has reached maturity, just as such families find but little place in the records of a sanatorium for pulmonary tuberculosis. The 1,000 members of the families of one child are, we will say for convenience, divided evenly from ages 20 to 49, inclusive, there being forty living at each age.

When these materials are arranged according to order of birth, the following is the result:

Order of siblings.	Age in years. Over 25	20–25	11–19	2–10	Total.
1	1520	480			2000
2	680	240	80		1000
3	600	240	160		1000
4	520	240	240		1000
5	440	240	320		1000
6	360	240	360	40	1000
7	280	240	360	120	1000
8	200	240	360	200	1000
9	120	240	360	280	1000
10	40	240	360	360	1000
Total..........	4760	2640	2600	1000	11000

We will now suppose that of the above group 148, or exactly 2 per cent of the total number of siblings beyond age 20, are college professors, the selection being made from each group in exact proportion to its members living at age 20 or over (I mean no disrespect to our professorial friends in naming this young age, merely desiring to make the statistics correspond somewhat to the facts of tuberculosis). Arranging these professors according to order of birth, and comparing them with the calculated number of cases which we should have if the professors were "drawn indifferently from all parts of the family in proportion to the total number of persons of each birth," we get the following:

Statistics about professors.

Order of siblings.	Number of Professors. Observed.	Calculated.	Percentage of actual to expected cases.
1	40	26.9	148
2	19	13.5	141
3	17	13.5	126
4	15	13.5	111
5	13	13.5	97
6	12	13.5	89
7	11	13.5	82
8	9	13.5	67
9	7	13.5	52
10	5	13.5	37

It will be obvious on mere inspection of this table, or of the accompanying graph, that the excess of elder born, and defect of younger born, is most marked. Testing by the usual process for goodness of fit, we conclude that the probability of such a distribution of older and younger members of a family occurring by random selection, lies between one and two in the ten million trials.

This is a truly wonderful discovery. It is very evident that a much larger proportion of the older born members of families become college professors, and the first born are evidently peculiarly subject to this dread complaint. These statistics when combined with the equally convincing statistics in regard to tuberculosis, insanity, crime, and albinism furnish conclusive evidence that the older born, and particularly the first born, are on the average inferior, physically, mentally, and morally, and that the later born are their decided superiors in these respects.

A further and most interesting and important point is to be noted as to the fertility of professorial stocks. Grouping the professors in our statistics according to size of family, we find that twenty belonged to families of one, and 128 belonged to families of ten. In the 148 families there were thus 1,300 children, the average size of the family being 8.8. This is a surprisingly high figure, and of course enormously greater than that of the general population. It furnishes convincing proof that "the families of the affected are larger, not smaller, than those of normals." The results are, in fact, so striking that we must really conclude that there is some connection between fertility and the tendency to professoritis. The exact nature of that connection, and which is cause, and which is effect, we are not yet able to say, but the fact of a connection is obvious. It is not impossible that by increasing the number of professorships we may be able to bring into operation a force that may effectively combat the tendency towards degeneration in the community resulting from race suicide, for with their large average families the numbers of later born and therefore superior individuals would be greatly increased. These statistics, moreover, confirm the necessity of modifying seriously our conception of the Mendelian theory, as already pointed out in connection with our study of tuberculosis.

My readers may smile at this; but this is precisely the reasoning which we are seriously asked by Dr. Pearson to accept as proof of the theories in connection with eugenics, which we have been discussing.

In conclusion, it will be noted that I do not claim that elder born children may not possibly be inferior, on the average, to later born of the same families. What I do say is that we should not be asked to accept this theory and the far-reaching conclusions based on it without positive and convincing proof. Statistics such as we have been considering are relied on as "proof," but they in reality prove nothing whatever. The proof has still to be produced. We require proofs, not assumptions.

If Dr. Pearson's theory be correct, it should be easy to establish that fact, without relying on fallacies. Exclude from statistics all families with less than say five children; exclude also all children that are too young to have been fully exposed to the risk under consideration; compare the later born with the earlier born of their own families only; make allowance for the fact that in cases where the risk is continuous, or partly continuous, during adult life, a man in middle or old age has had a longer time to develop the trouble than one just reaching manhood; carefully exclude all other sources of error; then give us the results, and we will judge of the truth or otherwise of the theory. It is quite possible that the offspring of immature parents may be less robust than others; but the assertion that the first child born to a couple who marry at age thirty is more likely to be a degenerate than the same child would have been had his parents married ten years earlier and had several children before him will require a lot of proof. Until such proof be furnished, we may be pardoned if we do not take the theory seriously.

HORSES AND HORSE BREEDING

H. K. BUSH-BROWN
Washington, D. C.

[Continued from second quarter.]

If not too presuming, I should like to make another suggestion about mules. By reason of the Celtic pony having no callosities on his hind legs and having the stripe down the back, and other characteristics like the ass, it would not be surprising to find that the progeny produced by reciprocal breeding would be fertile to themselves and perhaps to both parental families. Furthermore, if instead of the African ass, which is the farthest removed in type from the horse, the Dzeggetai, also Kaing or Asiatic ass were used, the chances of getting fertile hybrids would be increased, because the Asiatic ass is much more closely related to the horse than is the African type. Furthermore, he has only five lumbar vertebrae. If fertile mules can be produced, the way is open for a new hybrid species to be developed.

To return, then, to the original proposition: There are four families or species of horses, and as the type differences are so very marked it is important for breeders to know in a scientific way just what they are doing when they produce hybrids of any of these pure types.

And, more than that, if they are to make any success of breeding, then the pure types must be preserved pure, so that the fountain spring of the family can always be returned to for the pure and unmixed blood influence.

In order to understand the results of pure breeding, we must realize that to breed within the family is maintaining the pure type and to breed from one family to another is to produce the hybrid in

FIG. 14.—MONTGOMERY CHIEF, KENTUCKY SADDLE HORSE.

the same sense that the mule is the hybrid of the ass and the mare. In using the word "hybrid" in this way, I hope I am not misleading. Such a hybrid within the species is fertile, just as the white and black races make a fertile hybrid, but none the less a hybrid. Matings outside the species, like the mare and the ass, the coon and the cat, produce usually a barren hybrid, but all hybrids are not barren. Thus to breed the Connamara pony to the Iceland and the Fjord horse of western Norway is breeding within the family and maintaining the type, and the physical characteristics would thus be accentuated. The offspring would in consequence, if such breeding were continued

for generations, approach more closely to a prepotent type, and by careful selection of best specimens possess ever increasing qualities of excellence.

On the other hand, to breed the Celtic pony to one of the draft types would be breeding out of the family and produce a hybrid. In such a case what number of offspring would resemble one ancestor and what number the other has not been determined by any sufficient

FIG. 15.—BLACK BESS, GENERAL MORGAN'S FAMOUS MARE.
Sire Drennon, son of Dave Crocket—bred at Midway, Ky., dam by Imported Yorkshire, out of Margravine by Margrave. An early type of Kentucky saddle mare. Owned and used for a model by the late Henry K. Brown, sculptor.

investigation, but certain it is that unevenness of produce would prevail or a condition of atavism be established. Every breeder will form his own opinion, drawn by analogy from his past experience, if he will but realize that much of our breeding for the past few centuries has been of a hybridizing character. Thus from the Forest or draft type of mares and the Arab horse, or his Thoroughbred cousin, has been produced the French, German, and English Coach horse, the Hackney, Cleveland Bay and Hunter, Suffolk Punch, etc.

To what extent the Thoroughbred, the American Trotter, Kentucky Saddle, and the Morgan horse may be considered hybrids, I leave for my readers to decide after finishing this paper. We will all agree that they form one family group and are the most closely related to the Arab horse of all breeds in common use here. I do not mean by this any derogatory criticism, for the business of horse breeding has been

FIG. 16.—GENERAL GATES.
Morgan used by U. S. Department of Agriculture to reëstablish Morgan type.

pursued with all the intelligence available and the results have been good, but we can do much better in the future if the subject can be taken up in a more thorough and scientific way.

I should like to pause here to say that my serious study of the horse began when I was a boy and was stimulated by a visit of Alden Goldsmith to our studio at Newburgh, N. Y. He drove over from Chester with one of his fine trotters and spent the entire day with my uncle

FIG. 17. MORGAN STALLION DONALD, A. M. R. 5224.

Sired by Bob Morgan A M.R. 1519, Dam by Ethan Allen, 3rd A. M. R. 3987. The illustration was made from a photograph of the original paint-

talking about horses and everything pertaining to breeding and driving them. We had on the studio floor, as means of demonstration, the famous Kentucky mare Black Bess, a very remarkable animal, ridden by Gen. John Morgan in the Confederate army. One statement of Mr. Goldsmith's impressed me very much. It is as follows: "Horsemen and jockeys talk very glibly about 'bottom'; one horse has it and others do not. It seems to me that it is not impossible

FIG. 18.—HALEB, IMPORTED ARAB FROM THE DESERT.
Shown at Rutland in Morgan Class and given first prize as best Morgan type. Hobb's skeleton is in the National Museum.

that with sufficient study we will find that 'bottom' is merely a question of the length of the forearm and the distance from the thurl-bone to the hock. Extra length in these bones means that the leverage is greater and there is proportionately less bone below the knee and hock to be raised from the ground and carried forward. Thus the work is done with greater ease, and energy is conserved for endurance. In other words, the arms of your compass are longer and they measure more ground every time they are extended." This inspired me to study proportions in horses and to establish a relation of pro-

portion and capacities more carefully than I needed in my profession. I have done some research work but not of sufficient amount to permit me to formulate a standard of measure. All breeders will agree that between proportion and capacity there is an intimate relation, but I do not know any one who has reduced it to mathematical terms.

Here is another line of anatomical study. Suppose, for instance, that we select for anatomical study the Thoroughbred that makes the

FIG. 19.—CARMON.

Morgan and Thoroughbred used by U. S. Department of Agriculture on the Agricultural College Breeding Farm at Fort Collins, Colo., to establish an American Coach type by breeding to closely allied families. 24, 25, 26 are similar types, bred for conformation.

best record each year and have all his proportions taken while he is alive and in his prime, and then after he is dead have his skeleton prepared and deposited in the Museum for study. Suppose that this is supplemented in England by a study, in the same way, of the Derby winners, and similarly in France for the Grand Prix horses. If these studies were made on a uniform system and the results compared for a series of years, we should know a great deal more about the Thoroughbreds than we do now.

In a similar way we could study the trotting horse and perhaps be able to demonstrate in mathematical terms what constitutes a speedy horse at running and trotting, and then we might determine how best to breed and to select for training. Or suppose we select for study the best producers. Such selection would perhaps serve the breeders a better purpose.

The Museum of Natural History of New York is the best equipped

FIG. 20.—KHALED, SON OF NIMR.

to do this research work, as it has a department exclusively devoted to the study of horses. It will do all the laboratory work and issue reports free, provided the prepared specimens are sent it. To have the specimens prepared costs about forty dollars apiece and the breeders of horses should make their own selection and pay this first cost, as it is a special study in the interests of breeders.

Inasmuch as the blood of the Russian Prejevalsky does not seem likely to produce results of practical or artistic value, we may leave him in the Zoo as a curiosity. Thus we have the Celtic ponies, the

European Draft or Forest horses, and the Arabs as the three great families of useful horses. I look for very beneficial results from crossing the Celtic horses, the higher types of which are very serviceable and sturdy little animals, with the larger types of American horses, such as the Morgan, the Trotter, and the Thoroughbred.

FIG. 21.—CLAY CHILDERS.

Americo-Arab, a grandson of Nimr and a grandson of Linden Tree, one of the Arabs presented to General Grant by the Sultan of Turkey. The rest of the breeding is inbred Henry Clay, National Stud Book, Class "E," No. 4.

I should like to suggest here that the little Canadian pony, such as I remember in my boyhood, may have been a kindred of the Celtic pony.

To sum up our argument, then, the breeder should always keep the three families of horses and their constituent subgroups clearly in his mind as three distinct types or species, and in his breeding follow some definite law of continuity, such as to breed twice away from the pure type and once back to it. By laying out his own plan of procedure and recording his results he will have great joy

and success in his breedings and leave for others the benefit of his experience.

If there is any advantage in a horse having five lumbar vertebræ instead of six, the American horse breeders want to know it. A series of reasonable tests, such as mounting one-half a regiment of cavalry with purebred Arab horses, would help determine this question.

FIG. 22.—THE GREAT PRIZE WINNING ARAB STALLION ABDUL HAMID II.
Sired by Leopard, one of the Arab horses presented to General Grant by the Sultan of Turkey Abdul Hamid II. Dam an inbred Henry Clay mare. The result of breeding to a closely related family. Observe the Hogarth's line of beauty in his neck. First prize New York National Horse Show, 1894; First prize Baltimore Horse Show, 1894; Championship International Horse Show, Buffalo, N. Y.

Furthermore, a study into the tendency of nature to develop in the hybrid the qualities of its parents would be of infinite value to horse breeding. Here is a kind of research that is almost untouched and which appears to give promise of the greatest practical result, and I am of the opinion that such thoroughgoing scientific research will give a character to horse breeding that it does not now possess.

To keep within the family group or true-breed is not a new idea, for breeders of all the types have kept strictly to it in the subdivided lines, but too much in-breeding almost invariably produces degeneration. This is immediately corrected and revitalized by a return to one of the primitive types that have been kept pure.

We are yearly paying thousands of dollars of tribute money to Europeans for breeding stock and are content slavishly to follow their lead to merely perpetuate and continue the studbooks they have established. The exceptions to this statement are the Morgan horse, Kentucky Saddle, and the American Trotter; these are types of our

FIG. 23.—FEZ, A SON OF ABDUL HAMID II.

own of which we are proud, and the success here attained should give us courage to move forward and attain greater things.

Furthermore, we have the best Thoroughbreds in the world and of such quality that by carefully selecting them for breeding purposes and by crossing them with the above-mentioned American types we may produce higher types of the general utility horse than we have seen heretofore.

We have a goodly quantity of the two living primitive types, the Arab and the Celtic horses, and every subdivision of the draft type. We have therefore all the material that any people have for maintaining and strengthening the established types and for creating new ones, if we wish to do so.

Thus with scientific research and the application of knowledge gained to horse breeding we will become not only independent in our breeding, but the leaders of the world in the industry. Besides the live stock, we have the greatest variety of soil and climate, with well distributed and extensive grazing land.

The establishment of the Arabian Horse Club and their Registry of Arab horses was an important event in this country. It is the only studbook in the world, so far as I know, that continues the breed-

FIG. 24.—KASIM, SON OF ABDUL HAMID II, DAM AN INBRED HENRY CLAY, STRONG IN MESSINGER BLOOD.

ing of the Arab horse in its absolutely pure type just as the Arabs have bred it ever since the earliest times in history.

This should be followed by the establishment of registry for the Norway horse, the best representative we have of the Celtic type.

The National Studbook was established for the purpose of discovering the result of breeding the Arab horse to his closely related families in this country, the Thoroughbreds, Trotters, Kentucky Saddle, and Morgan horses. At the same time it gives free scope to the breeder who wishes to follow either narrow or broad lines in breeding and holds him strictly responsible for what he does. If he wishes to con-

centrate on existing types he can do so, and if he wishes to go afield and establish new ones he can do that and have the records of his breeding kept, so that if he succeeds the world will know how he attained his results, and if he fails it will also know how to avoid failure.

I believe no studbook has ever attempted to do this before, for the reason that heretofore race types have not been understood as they are now.

The effect of following the rules of the established studbooks has been to restrict breeding to the animals already registered and to

FIG. 25.—HOURAN, IMPORTED PURE ARAB BRED IN THE DESERT.

discourage the combining of closely related families which the laws of science required in order to attain the best results. What a horse is and what he can do is, however, the final test.

By making no restrictions other than keeping the classifications distinct, the National Studbook's rules leave it to the breeder to make his own plan and to prove his plan of breeding to be the best. The record discloses the breeding, and the photograph shows the result.

These studbooks require a photograph of the horse to be deposited, a form of record that is not now expensive and is quite worth while as a record of what is being produced.

For registration of existing types in this studbook it requires something more than speed records; there must be evidence of individual Arab characteristics to be worthy of breeding to the pure Arab.

By careful selection we will build up a selected Americo-Arab type. The United States Department of Agriculture has taken the initiative in this matter in selecting for restoring the Morgan type and in creating an American Coach horse.

By a proper coöperation and system of circuit breeding of selected units from our best native stock, we can establish a higher respect for the American-bred horse and become a nation of exporters of high-class horses instead of a nation of importers. We will have the best that soil, climate, science, and care can produce.

BREEDING OSTRICHES FOR PLUMES

Charles F. Holden
South Pasadena, Cal.

Twenty odd years ago Mr. Edwin Cawston conceived the idea of raising ostriches in southern California on a commercial scale. He went to Africa, collected some fifty good birds and arranged to have them shipped to this country. Many difficulties had to be overcome, not the least of which was the opposition manifested on the part of the South African Government. However, a few of the birds were finally landed safely in southern California.

Since that time immense improvements have been made in ostrich feather growing by applying American methods. The ostrich feathers of Africa are produced at times under very poor or adverse conditions, whereas the American ostrich feathers are the product of careful breeding, feeding, and care in the congenial climate near Los Angeles. The result is that the feathers are much finer, glossier, and stronger.

This ostrich farm is one of the most delightful spots in southern California. Originally it was one of those oak-clad arroyo banks found at intervals. All these splendid trees were preserved and made part of the general effect, many rare plants and shrubs being introduced. With judicious terracing, cobblestone ditches, and paths, fine landscape effects have been secured. In few places can one see such fine examples of Asparagus Plumosus, many of the fronds extending up onto the roofs of the buildings and high up into the oak trees. There are also splendid examples of ivy-draped oak trees.

The ordinary ostrich egg weighs about three and one-quarter pounds. The eggs are laid one every other day until twelve or thirteen have accumulated. Sometimes the mother bird refuses to sit, in which case the eggs are put into an incubator for the reason that the male bird, which usually covers them during the night, will not do so unless the mother covers them during the day.

In about forty days the eggs begin to hatch, and the chicks come out full fledged and quite strong, standing about twelve inches high. They are covered with short stubby feathers reminding one of a bunch of dark colored excelsior. For the first two or three days they eat nothing but bits of gravel and shell. Then they begin on the tender shoots of alfalfa and other green food.

The ostrich chicks grow very rapidly, increasing in size about a foot a month. During this period they require a great deal of attention

FIG. 1.—PADDOCK ON AN OSTRICH-BREEDING FARM IN CALIFORNIA.

as they receive no care whatever from the mother birds. During the incubation, however, the mothers are very faithful, covering the eggs during the hardest storms, even if the nest, which is merely a hole scooped in the ground, becomes filled with water. Young ostriches do not show any distinction of sex until they are fourteen months old, when the male takes on the black feathers.

There are two recognized varieties of African ostrich; the Nubian, which is the larger of the two, sometimes reaches a height of nine and one-half feet. The tallest ostrich in the Cawston flock stands eight feet high. When tempted with an orange or other dainty it can reach to a height of fully ten feet. The average height of these birds is seven feet. The eggs of the Nubian bird are larger and quite smooth and weigh between three and four pounds each. The period of incubation is forty days. The feathers of the Nubian are more curly but narrower than those of the South African ostrich. Crossed with

the South African they produce a finer grade of feathers than do either of the parent stocks.

The birds are plucked about every eight or nine months. They are not really "plucked" at all, but the wing plumes and the tail feathers are carefully clipped, one at a time, the stump of the quill being allowed to remain until it drops out of its own accord.

Feathers are graded to an exact scale. First they are sorted as to color. Then each given quality is assorted as to length, varying from the short ones up to plumes twenty-four inches long. Then each length is sorted as to width, there being six widths. This means that there are more than five hundred distinct grades of feathers. It must

FIG. 2.—CALIFORNIA OSTRICHES.

not be understood that this refers to colors at all. These five hundred different grades are each of them dyed into almost innumerable colors and shades, and one can therefore see that the total stock comprises thousands of varieties. The sizes of the fancy first grade feathers are about twenty-one inches in length and about fifteen inches in width. This size is worth on the market about $400 per pound; it takes eighty feathers of this size to weigh one pound, approximately. On the tip of each wing of the male bird there is one single feather called the bycock. It is a natural mottle of white and brown, and very beautiful. The black and the white feathers of the male birds are of equal commercial value. The feathers of the female bird have a value of

about 20 per cent less than those of the male. The average value of a plucking per annum is about $25; exceptionally good birds are worth as high as $45. Each wing has twenty-six plumes. There are about sixty tail-feathers. The feathers on the body of the bird have very small value and are used in making boas and other cheaper grade feather articles.

When feathers come to be manufactured after being dyed, the first process is another careful sorting for quality. It is as if a barrel of apples were graded, first for size and then were examined one by one to see that each conformed in every minute particular to the standard. Thus are brought together in each plume or boa or other article feathers not only of the same size and general quality but of such a texture that each will curl in just the same way.

Although the ostriches require a great deal of attention when small, once they are grown they are very hardy. So far the only disease known among the ostriches is what is called the Douglas worm, a minute parasite which clings to the walls of the stomach. This is not of a serious nature.

The neck of an ostrich is a wonderful part of its anatomy. The average length of the neck is a little less than three feet, but in the flock at the Cawston home farm, there is one big Nubian female with a neck measuring three and one-half feet. An adult ostrich when in full swing covers about twenty-two feet at a stride and can easily outdistance an ordinary horse. Their gait, both in running and walking, has a peculiar swinging roll which at first seems awkward, but there is a rhythm about it that is really very graceful.

The bill of an ostrich opens fully four inches, and an adult one makes no trouble over swallowing an orange whole—a big navel orange, with a diameter of three and one-half inches. Moreover, some ostriches will catch these oranges as fast as they are tossed, swallowing one after another until ten or twelve huge globes can be counted rolling down the long neck at the same time. The California ostriches are almost equally fond of sugar beets and quickly snap up rectangular chunks measuring from three to four inches, disposing of them much the same as they do of the oranges. The old saw about "a stomach like an ostrich's" is not altogether beside the mark, for the ostrich will eat literally anything, including nails and glass. They demand large quantities of gravel or other gritty substance. The omnivorous appetite of the ostrich often gives rise to amusing incidents at the Cawston farm. Perhaps the queerest stunt of all was when one old patriarch shot his head over the railing

and seized a long green veil fluttering from a lady's hat. Nor did he stop until he had drawn the veil off and swallowed it entire! An ostrich eats nearly one-fourth as much as a cow. They are extremely fond of green alfalfa and eat several pounds a day. They are also given large quantities of such vegetables as carrots, beets, turnips, etc. Their diet must be carefully arranged if they are to produce the silkiest and glossiest feathers. Rational methods of feeding and handling have increased the feather production of the birds very considerably.

FIG. 3—MALE AND FEMALE OSTRICH.

Of all animals, the ostrich has the smallest head in proportion to its body weight. The eye is about in proportion to the size of the bird and therefore appears out of proportion to the rest of the head. The ostrich's eye is about the size of a good-sized marble. However, he can see the most minute object. They are particularly attracted by anything that sparkles or glitters, and it is dangerous to be near them with any article of adornment. The eyelid of the ostrich does not move over the eye, but instead there is a separate film which flashes across it from time to time, reminding one of the shutter of a camera.

Attendants declare that these birds have no brains. They say that the man who has fed them and cared for them for years takes just as much risk in going into the pens as the utmost stranger. They

seem to manifest no feelings of affection or of friendship, such as most other birds or animals do. They are extremely treacherous—or a better word is "finicky"; a trivial circumstance will enrage them. They start a fight against other birds or against the keepers without any discernible provocation.

When an ostrich issues a formal challenge to fight, he sits down, spreads out his wings, draws his head back against his body, and then repeatedly flaps his wings while waving his head from side to side and bringing it against his body with a resounding thump. This is evidently more of an attempt to frighten off the enemy than a preliminary to fighting, for if one of them really wants to do damage he does not wait for any such preliminaries but issues a screaming hiss, throws up his wings, and pounces upon his opponent. The fighting is all done with the feet, for the bill of an ostrich is comparatively soft. The foot of the ostrich consists of one long toe, sticking out directly in front, which ends in a heavy thick claw, and a slightly shorter toe on the outside, standing at an angle. He fights by kicking—it would be more accurately described by the word "striking"—for he raises his foot as high as possible and then brings it down with a blow that would fell a cow. When ostriches are kept in flocks many individuals may be noticed whose breasts are torn and scarred from the savage down-cut of that cruel spur. Most commonly their fights are over family affairs. Ostriches mate for life and once mated the male will tolerate no interference from the unmated birds. This recalls that about four years ago one of the finest birds at the home farm killed his mate in the night by kicking her to death, and the attendants aver that it was because he was jealous of an unmated bird in the adjoining enclosure. He was afterwards turned back with the unmated birds and selected a new mate with which he has lived peacefully for four years.

The best producers at the farm are George and Martha Washington. These birds are twenty-four years old. They seem to have profited by their experience, for they hatch more chicks at a setting and do it with less fuss than any other pair. The attendants claim that they leave their nests longer and spend much less time and trouble than other pairs; still at each setting last year they brought off eleven fine chicks, whereas it is not unusual for a pair to secure only three or four or five chicks. If this pair have actually been as successful in past years as last, they would now have to their credit four hundred and forty ostriches. The life of an ostrich is between 25 and 35 years

SEPARATING HEREDITY FROM ENVIRONMENT[1]

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Brookline, Mass.

The question of the relative influence of heredity and environment has been a subject for debate since ancient times, but the results of such debates have not been clarifying. Indeed many have doubted that it is possible to separate the two interwoven forces; but this confusion and lack of progressive agreement in our ideas on the question I believe to be due to the failure to disjoint from the general problem each separate specific question and then to treat each separate inquiry by the methods of an approximately exact measurement. If this is done a certain amount of agreement can be at once established and the beginning made for a true science of the subject. Because a resultant is caused by two combined forces it is not necessarily impossible to resolve their relative strength. Viewed from one point of view, the problem certainly does seem hopeless; that is, it does not seem possible to gain any light as long as the discussion hangs upon the development of a single individual organism. Here it may be said that both conditions are of equal importance, or one may well contend that each aspect of the question is of supreme or absolute importance. In fact one may take any position one chooses and debate forever without arriving anywhere. For each separate creature, regarded apart from any others, the germ-plasm potentialities are one necessity and the air, water, food, and other environmental factors are another, and no one can separate the two. But as soon as two or more individuals are made the subject of the discussion we can begin to see possibilities of estimating the relative value of heredity and environment, not on the production of each individual separately but on the *differences* that exist between the two.

To make any distinction of this sort it is necessary to define heredity as the sum total of what is present in the single fertilized germ cell. It is important for the discussion to accept some such definition as this, and not the older idea that heredity means a resemblance between offspring and parent. As an instance to clear up this definition, and at the same time prove that it is at times possible to separate heredity and environment, we have but to think of the example of the gray and white mice or the black and white rabbits. All our breeding experiments show that in certain cases albino animals may be

[1] Read at meeting of research committees of the Eugenics Section at Munson State Hospital, Palmer, Mass., May 2, 1911.

surely expected from the mating of two colored parents. Here there is no resemblance whatever to either parent as far as color is concerned yet everyone will admit that these differences in color are due to differences in germ-cells and not to differences in environment. In the same way the anatomical sexual differences among the vertebrates are now for a great variety of independent and confirmatory reasons held to be due to germ-cell or predetermined differentiations and not caused by alterations in the food supply, heat, moisture, or other external agencies. In contrast to these cases, let us consider one or two examples of observable differences which are almost entirely the result of external surroundings. It would be readily admitted that any normal child of Caucasian parents might be made to speak English, French, or German, according as he were brought up among one or all of these three peoples. Whatever may be the inherent differences among individuals in their ability to learn languages, by far the greater part of the world's linguistic differences are obviously due to nurture and not to natural differences already present in the germ-cells. I have recently noticed a tabulation of the divorce statistics of the civilized nations of the world. Japan shows the highest ratio, United States next, and England and Ireland among the lowest. It is evident that the distribution of these differences does not accord with racial descent. If it did we should have no way of separating the inherited psychological factors from the social. The result might be due to either cause operating singly or to any hypothetical proportion of the two causes acting together. As it is, we may be sure that a large proportion of these differences are due to something other than physiological heredity, though our present knowledge of racial genealogy does not enable us to say just how much. Another instance of a resulting difference due to external circumstances would be shown if a farmer cultivate two plots of ground side by side of equal richness, and, after sowing a large amount of seed of equal average quality, he then applied a chemical fertilizer to one plot and not to the other. Since the average heredity factor would remain the same he could by shifting one external condition and keeping the others approximately the same, measure also any one of the other external forces, sunshine, soil, or water. These easy instances show that it is possible to get a certain amount of agreement as to relative values as to what can be done and what can not be done through outwardly imposed conditions. It is only a question of how far we can go. The researches of the future alone can decide.

Already it appears that certain generalizations hold as to the rela-

tive influence of environment, or, better, "modification," which is the more technical word. In Popular Science Monthly for April, 1910, I have brought together and analyzed the results of most of the modification experiments so far reported. These may be summarized in part and briefly as follows: Each organism, whether high or low in the scale of evolution, has from the time of conception and beginning of cell division, onward through embryonic and post embryonic life, an *expected* environment. In other words, it *expects* to develop and live under conditions which are essentially similar to those which surrounded its immediate ancestors at each stage of *their* career. If the expected environment is altered, then the modification which will accrue will in general diminish (1) in proportion as the change from the expected diminishes, (2) as the phylogenetic rank increases, (3) as the evolutionary rank of the tissue increases, (4) as the age of the tissue increases, (5) as the organism's power of choice increases. All this leads us to expect but little modification of the important mental and moral differences found among adult mankind. Researches on twins and my own statistical investigation concerning royalty as well as the more recent reports from the Eugenics Laboratory in London show that the rougher human differences are due almost entirely to heredity. Just where and when environment can be counted on to act remains to be determined. The point I wish to particularly emphasize is that each problem must be treated separately and in the light of specially contrived experiment or by specially devised analysis of statistics already in existence. In this way a science of the subject will slowly but surely grow.

SUGGESTIVE LABORATORY EXERCISES FOR A COURSE IN PLANT BREEDING[1]

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In a recent investigation made by the writer into the status of plant-breeding instruction in this country, it was found that one of the most irregular and un-uniform features of our present instruction is the laboratory work. This problem of methods and materials for laboratory instruction should demand our serious consideration. The quality of instruction is often measured by the amount and nature

[1] See article, by same author, on Lectures for a Plant-Breeding Course, in the Annual Report of the American Breeders Association, Vol. VI.

FIG. 1.—A CLASS OF STUDENTS AT CORNELL UNIVERSITY STUDYING THE MORPHOLOGY OF FLOWERS IN THE PLANT BREEDING LABORATORY.

of the laboratory work. There is no field of agricultural instruction which offers a greater and more valuable assortment of laboratory material than plant breeding.

The exercises here presented are merely suggestive. The length of time required for students to carry them out will vary with the exercise. The first one, for example, will require several weeks. No attempt has been made to group them in any chronological or pedagogical order. This must be determined for each class by its instructor. These exercises are intended to cover one year's work. The practicums do not call for extensive or costly laboratory apparatus. The accompanying photographs illustrate all of the apparatus necessary to carry on most of the exercises.

EXERCISE 1[2]

FIELD STUDY OF VARIATIONS BY MAKING AN HERBARIUM OF VARIATIONS

Have each student collect, press, and mount fifty variations of plants. This is an excellent exercise, for it calls the student's attention very effectively to the vast amount of variation in wild and cultivated plants. This exercise will consume several laboratory periods.

Material. A botanical collecting case, 20 blotters, 50 mounting sheets, labels, and glue.

The accompanying photographs represent specimens treated as above. The following directions may be given to each student.

DIRECTIONS FOR COLLECTING, PRESSING, AND MOUNTING AN HERBARIUM OF VARIATIONS

1. Search for fluctuations, plateations, mutations, and bud variations of plant characters which have been discussed in the lectures.
2. Collect as nearly the whole plant as practicable. The size of the mounting sheets is 11 by 16 inches. When you collect your specimens plan upon this size of sheet, and arrange them accordingly when you are putting them into the blotters.
3. Do not mount large, woody branches showing different degrees of thorniness, etc., upon the mounting sheets, but preserve them in bundles properly labeled.
4. If you wish to show variations of berries, such as thorn apples, etc., dry the fruits and fasten them to the mounting sheets by threads.
5. Leave specimens in the blotters until they are thoroughly dry. If you do not have enough blotters, take out the specimens which have been in the blotters for a week or so, and put them between pieces of newspapers, under pressure, until they become thoroughly dry. Then dry your blotters near a radiator and put in the fresh material.

[2] Credit is due to Dr. H. J. Webber for the original suggestion of this valuable method of studying variations in the field.

FIG. 2—SPECIMEN SHEET FROM HERBARIUM OF VARIATIONS.

Intended to show variation of leaves of the common horseradish. The data on the label record the fact of the name; locality where found, ravine on hillside; habitat, rich protected regions: description of variation, leaf finely divided; class of variation, fluctuation; collector, etc.

6. After the specimens have become thoroughly dry, stick them to the mounting sheets, preferably with glue, but photo paste may be used. Put a small band of adhesive tissue over the larger stems. Arrange the specimens, if possible, so that you have at least one variation on a sheet.

7. Put the label on the *lower right hand corner*, leaving a small margin. Attach the label to the mounting sheet with glue or paste, putting it only on the left edge of the label, that is, do *not* cover the back of the label with paste or glue.

Sample of label

HERBARIUM OF VARIATIONS

DEPARTMENT OF PLANT BREEDING NEW YORK STATE COLLEGE OF AGRICULTURE

Name ....

Locality .... Date ....

Habitat ....

Description of variation ....

....

Class of variation ....

Collector .... No. ....

8. Before the specimen is handed in fill in as many of the blank spaces on the label as possible. Fill in your name after the word "Collector." Fill in both the scientific and common names.

9. *Absolute neatness* is essential.

EXERCISE 2

STUDY OF THE MORPHOLOGY OF DIFFERENT KINDS OF FLOWERS

Object. To acquaint the student with floral parts and their functions. To determine the proper condition of the buds and flowers for emasculation, crossing, etc.

Material. Buds and flowers of various kinds and in different stages of development, microscope or hand lens, set of dissecting instruments.

Have the students make careful drawings of the floral organs.

The following outline by Mr. M. J. Dorsey may be found helpful in this exercise.

Study of Flowers (prerequisite to crossing)

Outline for general study of flowers:

- Flower—
  - Non essential organs—
    - Calyx—composed of sepals.
    - Corolla—composed of petals.

FIG. 3.—SPECIMEN SHEET FROM HERBARIUM OF VARIETIES.

Purpose is to show variations of leaves of the white mulberry. The data on the label record the name; location, campus; habitat, escaped from cultivation; description of variation, margin of leaves varying from entire to deeply lobed; class of variation, morphologic; name of collector, etc.

Essential organs—

Pistil—composed of

a, style; b, stigma; c, ovary $\begin{cases}\text{carpels.}\\ \text{placenta.}\\ \text{ovules.}\end{cases}$

Stamens—composed of

a, filament; b, anther $\begin{cases}\text{loculus or cell.}\\ \text{pollen.}\end{cases}$

Degree of cross-relationship—

1. Self- or close-fertilization. (Occurring in perfect or hermaphrodite flowers.)
2. Cross-fertilization. (Between individuals of same species or variety.)
3. Hybridization. (Between species and sometimes between varieties which are very distinct.)

Causes of sterility—

1. Stamens and pistils maturing at different times. (Dichogamy.)
2. Lack of affinity between pollen and stigma.
3. Scanty or insufficient pollen.
4. Lack of viability of pollen.

Relative position between stigma and anthers—

1. Stigma and anthers the same height.
2. Stigma above anthers.
3. Stigma below anthers.

Relative maturity of pistil and anthers—

1. Both maturing at same time.
2. Stigma matures first.
3. Anthers mature first.

Methods of fertilization—

1. Insects.
2. Wind.
3. Self-fertilization.

Types of plants with respect to sex—

1. Monœcious (both sexes on same plant).
2. Diœcious (each sex on different individuals within the species or variety).

Types of flowers with respect to sex—

1. Imperfect (1) Staminate—bearing only stamens.
   (2) Pistillate—bearing only pistils.
2. Perfect or hermaphroditic—bearing both stamens and pistils.

Determine the following:

(a) Number of parts to flower—
a, sepals; b, petals; c, stamens; d, pistils.

(b) Type of flower—perfect (hermaphrodite) or imperfect.

(c) Relative position of stigma and anthers.

(d) Relative maturity of pollen and stigma.

(e) Is the flower fertilized by insects, wind, or selfed?

(f) Draw the essential organs and label each part.

EXERCISE 3

TECHNIQUE OF THE CROSS-POLLINATION OF PLANTS

This exercise may be carried out in the winter in a greenhouse or conducted in the fall and spring out of doors, where additional expense is not involved in growing the plants under glass.

The following suggestive directions may be given to each student.[3]

Pollination or crossing of plants

"Pollination is the act of conveying pollen from the anthers to the stigma."
—Bailey.

Materials: 1. Instruments: Tweezers, scalpel, small sharp-pointed scissors, etc.
2. For covering flowers: Manila bags, waxed paper bags, cheese cloth, etc. Wire labels, stringed tags, etc., may be used to fasten the bags.

Preliminary study of plant:

Before attempting to cross plants, it is necessary to know the structure of the flower to be used. To do this (A) locate all parts—sepals, petals, anthers, filaments, stigma, style, ovary; (B) determine whether the flowers are perfect or imperfect; (C) learn to recognize the "ripe" or receptive condition of the stigma and pollen.

Technique:

(A) Emasculation. (Unnecessary where stamens and pistils are borne on different flowers.) For crossing purposes select flowers in which the anthers have not opened. Remove the anthers with tweezers or scalpel, taking care not to injure the stigma. It may be necessary to remove part or all of the petals in some flowers in order to get at the anthers, but it is best to remove only the anthers, if possible.

(B) Bagging. After the anthers have been removed, the flower should then be covered with some material, as a manila or oil paper bag, to prevent the entrance of foreign pollen. When the stigma is receptive, remove the covering, pollinate with the desired pollen of known purity, and immediately cover again, leaving cover on until fertilization has taken place—as indicated by withered or brownish stigma. It is desirable to remove the covering when the cross has "set."

(C) The record. The record should include a description of each parent form, giving particular attention to the contrasted characters. Colors may be recorded by comparing with a standard color chart. The female parent should always be mentioned first. The record on the label should include variety name or number of each parent, date of emasculation, and pollination. (Name of worker can also be placed on the label.) As far as possible reciprocal crosses should be made.

EXERCISE 4

FIELD STUDY OF EAR-TO-ROW TEST OF CORN

This exercise should be conducted in the fall, and the corn may be either left standing in the rows where it grew or cut and shocked, each row being kept separate.

[3] The writer wishes to give credit to Mr. M. J. Dorsey for some of the suggestions appearing in this exercise.

Object. To test the transmitting power of individual ears of corn.

Material. Small plat of corn, standing or in shock, planted by ear-to-row method; baskets and scales.

Have each student fill in the following form for each row:

Row Number.	Height in feet.	Number of stalks.			Number of ears.		Total yield in pounds.	Yield per stalk.	State of maturity.	Remarks
		Eared.	Barren.	Total.	Good.	Poor.				

EXERCISE 5

LABORATORY STUDY OF EAR REMNANTS OF KNOWN PERFORMANCE

In the preparation of Exercise 4, one-half of each of the parent ears should be saved for this exercise, and the other half planted.

Object. To study the correlation between ear type and ear performance.

Material. Half ears of corn, each numbered, and the data from their corresponding rows as obtained in Exercise 4.

FIG. 4.—APPARATUS FOR CROSS-POLLINATION.

Set of instruments, bags, string, notebook, and a copy of the standard color book, "Repertoire des Coleurs," for accurately describing the color of flowers, etc.

EXERCISE 6

STUDY OF TUBER UNITS OF POTATOES

This exercise should be conducted in the field in the fall. The potatoes should have been planted by the four-hill-unit system, that is, each four hills having the same progeny number should come from the same mother tuber, and they should be so planted and staked that the progeny of the seed end or apex of each mother tuber may be distinguished from the progeny of the base or stem end.

Object. (a) To test the transmitting power of individual potatoes. (b) To test the yield of base and apex.

Material. Small field of potatoes planted by the tuber-unit system, previously dug and each hill replaced where it grew but exposed to sight; sets of scales.

Have each student fill in the following form for each hill:

Progeny number										
Parent number										
Seed from stem end or seed end										
Total weight of hill										
Weight of marketable tubers										
Percentage of marketable tubers										
Total number of tubers										
Number of marketable tubers										
Average weight of tubers										
Shape										
Regularity										
Color										
Depth of eyes										
Amount of disease										

EXERCISE 7

Field Trip to Experimental Grounds

Most experiment stations have plant-breeding experiments under way, and if a fall inspection of the plats would be instructive to students they should be taken on such a trip early in the fall and required to make careful notes.

EXERCISE 8

Laboratory Study of Variation in Potatoes

(a) Students should make up a score card for potatoes to fix in mind ideals towards which to breed. (b) A careful study should be made of the data obtained from Exercise 6. (c) Hills of potatoes weighing $\frac{1}{2}$, 1, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, 3, and 4 pounds should be made up and drawn natural size, in notebooks.

Objects. (a) To gain a better knowledge of potatoes. (b) To study their variation statistically. (c) To fix in mind how hills of different weights look. (d) To calculate the theoretical yields per acre with certain weights per hill.

Materials. Ten potatoes to each student; data from Exercise 6; scales; a few bushels of potatoes.

The following outline may be used:

1. Make score card for potatoes.
2. Total weight of ten tubers.
3. Average weight per tuber.

4. Make up hills weighing $\frac{1}{2}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, 2, 3, and 4 pounds. Draw each natural size.

5. Compute yields per acre from above weights per hill, assuming the hills were planted in rows 3 feet apart and 18 inches in the row.

EXERCISE 9

Corn Judging

Students of plant breeding should be trained to have a critical judgment of agricultural and horticultural plants. Exercises in comparative judging are the best way to attain this end. Utility should be kept constantly in mind.

Details of corn judging will not be given here; they are too well known to need emphasis. For the east, both dent and flint varieties should be used. The ears which are judged in this exercise may be saved for Exercise 10, which should always accompany Exercise 9.

Object. To encourage critical judgment of corn and, by the same means, of other crops.

Materials. Ten ears of different races and types of corn to each student; tape, scales, charts, etc.

Each student should score sample of flint corn according to the following score card:

New England Flint

	Points
Maturity and seed condition	20
Uniformity (or regularity of single ears)	15
Kernels	15
Weight of ear	10
Length and proportion	10
Tips	5
Butts	10
Sulci (space between rows)	10
Color	5
Total	100

EXERCISE 10

Statistical Study of Ears of Corn

This should accompany and follow Exercise 9.

Object. (a) To study critically and statistically the various parts of ears of corn. (b) To work up these data by biometrical methods, drawing curves, and ascertaining mean, standard deviation, coefficient of variability, etc., for the various parts of the ear. (c) To illustrate testing for germination.

Materials. Each student should be given the same ears of corn which he had for Exercise 9; tapes, scales, and germinators of various kinds suitable for testing corn.

The following form should be filled in by each student:

Study of Corn.

Variety: Dent, flint, sweet, pop. (Underline.)

Where grown

(a) Length of ear in cm.

(b) Circumference of ear in cm. (⅓ butt to tip)

(c) Weight of ear

(d) Number of rows

(e) Circumference of cob (⅓ butt to tip)

(f) Weight of shelled corn

(g) Weight of cob

(h) Percentage of shelled corn

(i) Total number of kernels

(j) Average weight of kernel

(k) Width of kernels in cm. (taken at random)

(l) Compute average width.

(m) Length of 50 kernels in cm. (taken at random)

(n) Compute average length

(o) Dissect kernels—where does the color lie?

(p) Draw typical kernel (side view) natural size

(q) Make germination test

EXERCISE 11

STUDY OF CORRELATIONS OF CHARACTERS IN CORN

Use the same data as employed in Exercises 9 and 10. Make correlation tables by accepted biometrical methods, of such characters as length and circumference; length and number of grains; weight and number of grains; length and weight; etc. Work out correlation coefficients.

Object. To find out if certain characters are associated so that a measurement of one will give an indication of the other.

Materials. Data from Exercises 9 and 10; cross-section paper.

EXERCISE 12

STUDY OF VARIATIONS IN PRESSED SPECIMENS OF RAGWEED, OR SOME PLANT SHOWING MANY DIFFERENT TYPES

Object. Careful study of the large and small variations between different biotypes of ragweed (*Ambrosia artemisifolia*).

Materials. Specimens of many different types of the above plant or any kind of plant which is rich in biotypes. These specimens should be carefully pressed and mounted. Have each student make detail drawings showing minute differences.

EXERCISE 13

STATISTICAL STUDY OF APPLES FROM DIFFERENT TREES

Object. To study the individuality of fruit trees.

Materials. Apples representing the total product of different trees; scales; calipers.

Fill in the following form for each tree. Plot curves representing the entire population of trees.

Name of variety

Tree No.

Age of tree	
Condition of tree	
Total number of apples	
Number of marketable apples	
Total weight of apples	
Weight of marketable apples	
Average width of 50 apples	
Average length of 50 apples	
Color	
Any other noticeable differences	

EXERCISE 14

STATISTICAL STUDY OF BRANCHES OF DIFFERENT TREES

Object. To continue the study as outlined in Exercise 13 to test the individuality of trees.

Materials. Fruit trees of different kinds, dwarf trees preferable; tapes.

Measure the new growth of various parts of each tree and of different trees. Plot curves of each tree and of all of the trees as a population, thus showing graphically the extent of bud variation present.

EXERCISE 15

STUDY OF OAT AND WHEAT HYBRIDS

Object. To study Mendelian dominance, segregation, and recombination of characters in second-generation oat and wheat hybrids.

Materials. First and second-generation oat and wheat hybrids. These should be chosen so that the parents have conspicuous differentiating pairs of characters. For example, black and white grains in oats and bearded and beardless types of wheat.

Give each small group of students several bundles and have them count the various types. Put all of these counts together and compare them with theoretical Mendelian ratios.

EXERCISE 16

STUDY OF CORN HYBRIDS

Object. (a) To determine the unit characters of corn and their behavior in transmission. (b) To study the immediate effect of pollen, or Xenia, in corn.

Material. Provide first and second-generation hybrid ears of corn with various known types of parentage.

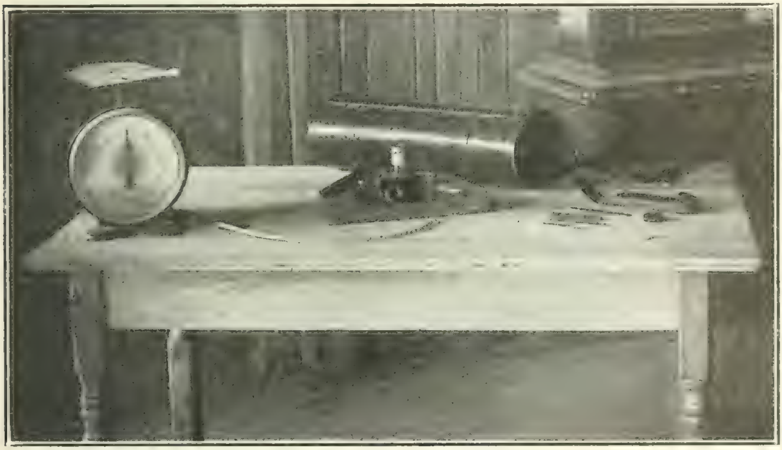

FIG. 5.—SAMPLE APPARATUS FOR CONDUCTING PLANT-BREEDING EXPERIMENTS. Most of the experiments here described can be carried out with this equipment.

Have each student study the kind and position of the color in a kernel of corn and trace the behavior of these colors throughout the two generations. Trace also any other factors which may appear to segregate during transmission. Count the dominant and recessive characters and determine their number as compared with theoretical Mendelian ratios.

EXERCISE 17

STUDY OF CITRUS HYBRIDS

Object. (a) To study the possibility of obtaining valuable kinds of citrus fruits by means of hybridization. (b) To study the structure of citrus hybrids as compared with their parents. (c) To study the economic value of these hybrids.

Materials. Obtain from some of the extreme southern experiment stations, or from nurserymen or growers, samples of citrus hybrids, such as citranges,

tangelos, and the like, and samples of *Citrus trifoliata.* Purchase oranges, lemons, grapefruits, and tangerines from the fruit stores. Provide also for each student, or group of students, a glass, spoon, sugar, and water.

Compare the hybrids with their parents, with special reference to the following points:

(a) *Fruit*—size, shape, color, amount of juice, quality of juice, condition of segments, etc.

(b) *Trees* (if branches or photos are available)—size, shape, branching, kind of leaves, etc.

(c) *General*—length of season, resistance to cold, etc.

Squeeze out the juice from several fruits, add sugar and water, and test the adaptability to beverage and other economic purposes.

EXERCISE 18

Illustration of the Application of the Law of Chance

Object. To demonstrate how such ratios as 3 : 1; 9 : 3: : 3 : 1, are the result of the laws of probability.

Materials and Methods to illustrate the union of gametes where one pair of characters is concerned:

(a) Provide a closed vessel containing black and white beans of the same size and shape; or,

(b) Provide a pack of playing cards.

Draw at random two beans or two cards at a time. Record each combination observed. Two blacks coming simultaneously illustrate a homozygous black individual; a black and a white represent a heterozygous form appearing as black; and two whites illustrate a pure recessive.

Materials and Methods to illustrate the union of gametes where two pairs of characters are concerned.

(a) Provide a closed vessel containing yellow and white kernels of both flint and dent corn of as near the same size and shape as possible. Here we have illustrated gametes representing four combinations of characters as follows: Yellow flint, yellow dent, white flint, and white dent.

Draw at random two kernels at a time. Record the visible types of individuals which each combination of gametes would produce, assuming yellow dominant over white, and flint dominant over dent. The theoretical ratio would be 9 yellow flint : 3 yellow dent : : 3 white flint : 1 white dent.

Similarly two packs of cards having different kinds of backs may be used and assume one kind dominant over the other. Shuffle all together and draw two cards at a time.

EXERCISE 19

Study of Bud Variations and Reversions in Ferns

Object. To determine the nature and amount of reversion from the parental type, and if possible to find some cause for the same.

Material. Obtain specimens of the sword fern (*Nephrolepis exaltata*) and Boston fern (*Nephrolepis bostoniensis*) and as many of the other ferns named below as possible.

Study the trueness to type of each variety and any reversions which they may contain. Draw typical specimens.

The following is the history, according to Dreer, of some of the fern varieties:

	Introduced in	Sport of—
Nephrolepis bostoniensis	(?)	Nephrolepis exaltata (Sword Fern)
Nephrolepis piersoni	1903	bostoniensis.
Nephrolepis elegantissima	1904	piersoni.
Nephrolepis scotti	1904	bostoniensis.
Nephrolepis barrowsii	1905	piersoni.
Nephrolepis whitmani	1906	barrowsii.
Nephrolepis todeaoides	1907	whitmani.
Nephrolepis superbissima	1908	bostoniensis.
Nephrolepis scholzeli	1909	scotti.
Nephrolepis pruessneri	1909	whitmani.

EXERCISE 20

DRAWING MAPS OF FARMS SHOWING THE LOCATIONS OF BREEDING PLATS AND THEIR RELATION TO THE REST OF THE FARM

Object. To demonstrate methods whereby plant-breeding trial plats may be made to articulate with the layout of fields for ordinary farm operations.

Materials. Outline maps of certain farms showing the layout of fields and the methods of rotation.

Sketch testing plats in convenient places where the soil is uniform. Determine the amount of land necessary for a potato-breeding plat, a corn-breeding plat, etc. Place the corn-breeding plat at a safe distance from the general field of corn.

EXERCISE 21

PRACTICE IN THE CROSS-POLLINATION OF APPLES, PEARS, PEACHES, PLUMS, ETC.

To be carried on in the spring, when the trees are in blossom.

For general methods of procedure see Exercise 2.

EXERCISE 22

STATISTICAL STUDY OF THE AMOUNT AND QUALITY OF GRAPES FROM DIFFERENT GRAPE VINES

Use the same general method as in Exercise 12.

EXERCISE 23

STUDY OF THE RESULTS OF THE PLANT-TO-ROW TESTS OF WHEAT, OATS, CABBAGE, ONIONS, OR ANY CROP WHERE DATA ARE AVAILABLE

See Exercise 3.

EXERCISE 24

EMBRYOLOGICAL STUDIES FROM SLIDES SHOWING CELL DIVISION AT DIFFERENT STAGES, CHROMOSOMES, POLLEN MOTHER CELLS, OVULES, ETC.

Provide each student with a high-power microscope and microscopic slides mentioned above. Careful drawings of each slide should be made.

EXERCISE 25

STUDIES OF ORIGIN OF VARIETIES—CORN, WHEAT, APPLES, PLUMS, GRAPES, ETC.

Literature study of the history of varieties. Methods employed to originate varieties should be carefully noted.

THE CORN BREEDER'S PROBLEMS

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It was many years after wonderful results had been accomplished in breeding fruits and flowers that attention turned to our most valuable plant—corn. Of recent years by numerous means the great value and possibilities of this crop have been brought to the attention of the public. Good results have been accomplished, but not to the extent expected, considering the general appreciation of the value and possibilities of the crop. This is due to the small amount of careful and persistent field work that has been done.

Now that the possibilities of corn improvement have been so fully published, some are turning their energies to field work in attempts to accomplish this improvement. The actual doing of this work has brought out many problems, making the work more complex than was at first supposed. These problems call for more determined and persistent effort. The enormous returns that will follow an increased yield of one bushel of corn for every acre planted have been too fully expounded to allow complexities to prevent accomplishment. Corn breeders must make good. The field work must be done, and to do it properly fundamental principles of corn improvement must be established, and methods of making field tests so improved that they will be reliable.

Until recently the accomplishment of results has been expected of the farmer, and he has accomplished about all that has been done, but it is now evident that corn breeders have duties that can not be shifted upon the busy farmer. Ranchmen have adopted and propa-

gated improved breeds, the product of years of careful work of skilled animal breeders. Farmers will readily adopt and propagate improved and adapted strains of corn as soon as corn breeders originate them and demonstrate their superiority.

The fact that the various strains of corn of a neighorhood when comparatively tested as to productiveness show differences of 5 or 10 bushels per acre is sufficient proof that corn breeders should determine the causes of these differences and perfect methods whereby farmers may be supplied with seed of the highest yielding strains.

Division of corn-breeding work.—Great undertakings along any line require careful planning of the work, and a division of the tasks involved. The various features of corn breeding have a bearing upon the profits of almost every farmer of the country. But the necessary work has not been sufficiently well planned nor its various tasks sufficiently well allotted to various grades of workers. The task naturally divides into two principal parts—(1) the determination of causes influencing improvement; this is the investigator's work; and (2) the practical application of methods producing improvement; this is the corn breeder's work. These two lines of corn-improvement work are distinct. Each needs a specially trained corps of workers. The results obtained by the one will help the other, and working together they can provide the farmer with seed of much more productive strains than his own ability or facilities enable him to produce.

The investigator's problems.—The care of the corn crop is such a universal line of work that there naturally exists the general impression that it embodies no difficult problems. This impression is soon removed from the mind of the investigator attempting to determine why some strains are more productive than others. His investigations reveal numerous factors simultaneously exerting influences the effects of which he would like to consider singly but is forced to consider collectively.

The corn breeder who is desirous of making his business profitable as well as of benefit to his neighbors can not be expected to determine, for instance, the effects that will result from changes of environment, the best methods of utilizing the effects of adaptation and acclimatization, the relative values of centgener selection and of cross-breeding and their best combinations, the comparative value of different test-plat methods, the effects on productiveness of preserving seed corn under different degrees of temperature and humidity—and yet these questions have a vital bearing upon the success of his business.

The practical breeder can make separate germination tests of every

ear of seed corn he sells, and guarantee 98 or 99 per cent of the kernels to germinate, but it is a problem for the scientific investigator to determine whether there is really any relation between the percentage of germination and productivity. To be sure, it is very generally taken for granted that seed that germinates 99 per cent is more productive than seed of the same strain that germinates but 50 or 60 per cent, yet very careful tests have shown that the productivity of seed corn may be greatly reduced by exposure without reducing its germinating power. Other tests have shown that seed corn four or five years old, and of which but 50 or 60 per cent of the kernels would germinate, produced as well per acre and per plant when sufficient seed was planted to obtain a perfect stand as one-year-old seed of the same strain which germinated 98 per cent or better. Is it a question of the early death of kernels of low producing power and the survival of those having vigor and highest yielding power, or did the kernels outlive attached germs of disease that grow with and reduce the producing power of the plants?

Seed corn that germinates 99 or 100 per cent at maturity with proper preservation will hold its vitality four or five years, while that which germinates but 70 or 80 per cent at maturity will lose most of its vitality within a year or two.

Practical seed-corn dealers often find artificial heat beneficial in keeping seed corn dry, but investigations may prove that a low temperature and dryness will better retain its producing power. Do the warm, humid winters of the South reduce the producing power of seed corn more than the cold and dry winters of the North? Why is seed corn grown during a certain season or on a particular soil of higher yielding power than seed of the same breeding grown during other seasons or on other soils?

These problems are numerous and complicated and their successful solution calls for a perfecting of methods, carefully drawn plans for the solution of each problem, and then the execution of the plans with as much precision, and by as intelligent investigators, as those who solve problems of chemistry or astronomy. Results of test-plat work will continue to be unreliable if the field work is delegated to unreliable workers.

Reliable methods must be originated and standardized.—Without test-plat methods the results of which can be depended upon, neither the investigator nor the practical breeder can measure the results of his efforts or know what he is doing. Neither can he who casts aside all test-plat work as worthless and resorts to theorizing regard-

ing generalities render assistance in originating more profitable strains of corn. Generalities are valuable for some purposes, but living, growing plants present so many exceptions to general laws that each case must be tested to determine whether it is a conformation or an exception. Furthermore, it is often the exceptional variety or individual which brings most profit to the breeder.

The need is not for methods of finer discrimination but for reliable methods. The problem is not one of finding the seed ear that produces most pounds and ounces, but one of finding methods that prove the increased productiveness to be inherent and not due to differences of soil, of moisture, of heat, of space, or of seed preservation, or to any other factor than the one under investigation.

Another way of rendering results reliable is by making the tests a large number of times under conditions as nearly identical as possible, considering the problem unsolved until every test gives the same result or permits of otherwise satisfactory explanation.

There is no better means of establishing the reliability of methods of breeding than by submitting them to the experienced members of the American Breeders Association for criticism, amendment, and adoption. To avoid generalities just referred to and institute a step toward the adoption of standard methods, one is here submitted for testing the relative productiveness of different varieties of corn requiring similar conditions for growth and productiveness, and for testing the relative productiveness of different ears of a variety. In either case the method is essentially the same.

Among fourteen first-generation crosses, the productiveness of which was tested in 1910 in comparison with the parent varieties, three were found more productive than either parent; to be concise, one to the extent of 19 per cent. The method illustrated in the diagram below will be used in testing the relative productiveness of 100 ears of this advantageous cross, that remnants of the highest-yielding ears may furnish seed for a breeding plat.

The test plat will be marked off in both directions and planted with seed of the cross by the ear-to-row method in one direction (shown in diagram as seed 1, 2, 3) and with alternate rows of the two parent varieties by the ear-to-row method in the other direction (seed A, B, A, in diagram). Sufficient seed from each of two ears will thus be planted in each hill to permit thinning so that each hill will contain, on the west for instance, a stalk of the cross and six inches to the east a stalk from an ear of one of the parent varieties.

At harvest two men work together, one gathering the yield from

the cross in row 1 at the time the other gathers the yield from the parent varieties, A, B, of the same row, only perfect hills, i.e., hills containing one normal stalk of the cross and one of a parent, being considered. By this method a uniform check grows in each row and the relative productiveness of the 100 ears of the cross is obtained by comparing each with its check. This method reduces the exaggerated superiority of rows which by their unusual thrift gain ascendency, overgrow, and impose upon adjoining rows. A duplication of the entire test can be had by making the rows planted with the cross

DIAGRAM ILLUSTRATING METHOD OF PLANTING BREEDING PLOT OF HIGH YIELDING CORN. Nine hills in northwest corner of the test plot; grains numbered 1, 2 and 3 represent grains from different ears of the cross; letter A represents one parent, B the other; small figures, as A′, B′, A², represent different ears of A and B.

60, 80, or 100 hills long and dividing the plat into two similar halves of 30, 40, or 50 hills to the row.

The practical corn breeder's problems.—The practical breeder's problems are directly connected with the growing, preserving, and delivering of seed corn that will meet the varied needs of corn growers. Local demonstrations of high productiveness will cause ready sales of seed corn. Many of the corn breeder's problems will be simplified by the exercise of good judgment. Corn-breeding work can not be done by machinery—the scales will determine which yields heaviest,

but the heaviest may be the least desirable because of high water content or poor keeping qualities. Forty bushels per acre of ninety-day corn may be more valuable than 60 bushels of a variety maturing so late as to necessitate additional irrigation and cultivation, or prevent using the land for another crop.

The breeder must become familiar with all tendencies and variations of the variety with which he works.

Almost every attempt to solve a problem concerning corn breeding discloses other problems. The purpose of this article will have been accomplished if it has made clear the fact that possibilities in breeding corn have not been approached, and that an adequate attempt to accomplish them calls for—

1. Standardization of methods.
2. A definitely planned system for the solution of each problem.
3. An allotment of the problems according to their complexity to conform to the ability of different breeders.
4. Persistent field work upon a single problem till all influencing factors are sufficiently under control to permit the accomplishment of uniform results.

GEOMETRICAL FIGURES IN PLANT BREEDING

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In working upon some of the breeding factors in peppers, it has been found convenient to use geometrical figures to express to the eye the combinations that have been made.

In the case of (1) the position of the fruit, whether pendent (dominant) or upright (recessive) upon the branch, and (2) the flavor of the fruit, whether pungent (dominant) or sweet (recessive) ("hot" and "mild"), triangles and their derivatives may be constructed that are helpful. The accompanying "16-square," familiar to all breeders, is filled up with these figures.

In order to designate over-lapping, the pollinator is uniformly drawn in solid lines—that is, uppermost—and the embryo sac determinants with broken lines.

In all instances, when the two parental figures are alike in shape and position, the offspring is pure of that figure as shown in the four in the diagonal from square 1 to 16, but, of course, no two of these are the same; thus, 1 and 6 are both hot (sharp-pointed) but the direc-

tion of the point indicates that in 1 the fruit is pendent and in 6, upright. In like manner, in squares 11 and 16 the position is the same for the lower numbers of each pair but the triangle tip is lacking in the last—that is, the fruit is mild.

There are four other squares that bear plain triangles, namely, 3, 8, 9, and 14—that is, two pairs with the common value 5 between

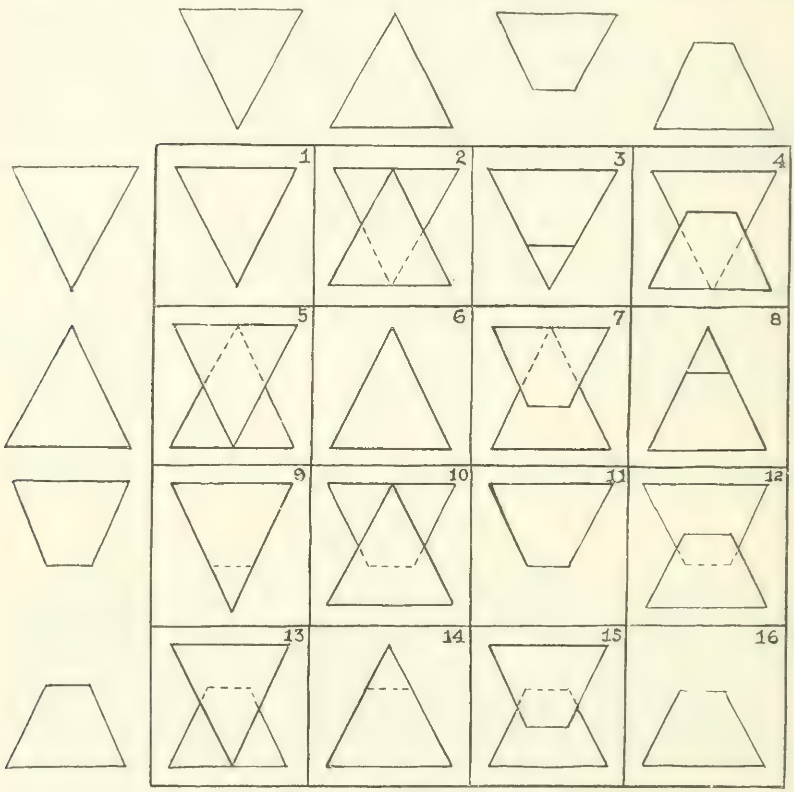

FIG. 1.—A 16-BREEDING SQUARE.
Triangles and polygons replace letters to express the combinations when two pairs of una are represented. The male gametes are figured above and the female at the left.

them and they differ in the direction of the angle—that is, 3 is pendent and 8 upright, while 9 is pendent and 14 upright; but the last two are reciprocals of the first two respectively. That is, 3 and 9 differ in the relation of the parents to the qualities under consideration and this is shown by the solid and dotted short line indicating the mild nature of one parent,—that is, the male parent in 3 is mild

and 9 in the female. The same reciprocal relationship is shown by the same lines for 8 and 14 where both are hot and upright.

The polygons are eight in number, alternating throughout with the triangles, and are grouped as four pairs of reciprocals, thus the ones at 2 and 5 (three being the number of units between them) show that, while both are hot and upright, the dotted lines indicate a difference in the relation of the parents to the una in question. In like manner, 12 and 15 show at once the lack of sharp angles and therefore both are mild and pendent but reciprocals.

In the diagonal from 4 to 13, crossing the other diagonal of the pure offspring, 7 and 10 (with the common difference of three) fill up the cross-lines from 2 to 12 and from 5 to 15 in the chart; and are

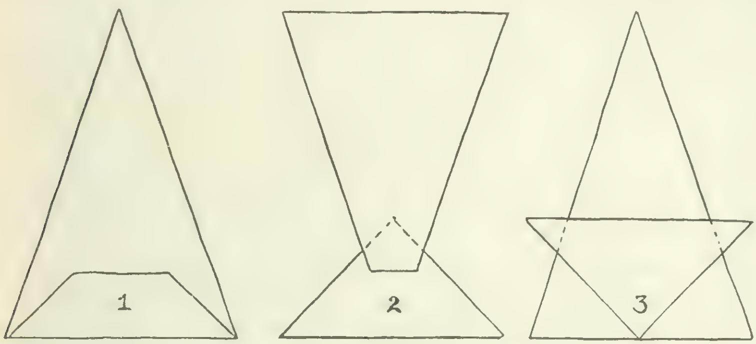

FIG. 2.
At 1, 2, and 3 are geometrical figures used to show different combinations when four pairs of una are involved in the breeding.

reciprocals of the ordinary sort,—that is, without the dominants and recessives both borne by the same parent,—the latter being a rare condition that obtains in the opposite corners,—namely, 4 and 13, where 4 has both recessives brought by the pollen to the dominants in the egg-cell, while in 13 the reverse is true, making this a paired reciprocal.

If one wishes to study certain figures without the confusion that the presence of the others may induce, all but those desired can be quickly excluded by using gummed paper flaps to cover any figures temporarily.

In the case of the peppers, there are the tall and the dwarf sorts and this pair of allelomorphs can be readily accommodated by making two sides of the triangle somewhat prolonged for the tall type.

In 1 the dwarf, upright, sweet, red (color here omitted) pepper is bred upon a tall, upright, hot, yellow sort. The reciprocal of this would be shown by dotted lines for the female parent. At 2 is expressed geometrically that a tall, pendent, sweet, red sort is bred upon a dwarf, upright, hot, yellow variety; and in 3 a dwarf, pendent, hot, red is the pollinator for a cross upon a tall, upright, hot yellow.

The use of symbols in plant breeding is no new thing and doubtless many workers' notebooks show various symbols that do not find their way into print. Mendel employed them freely and whole pages of Bateson's "Principles of Heredity" are literally covered with diagrammatic symbols, especially when pedigrees are visually expressed.

SPERMATOGENESIS, OR ORIGIN OF THE MALE GERM CELLS

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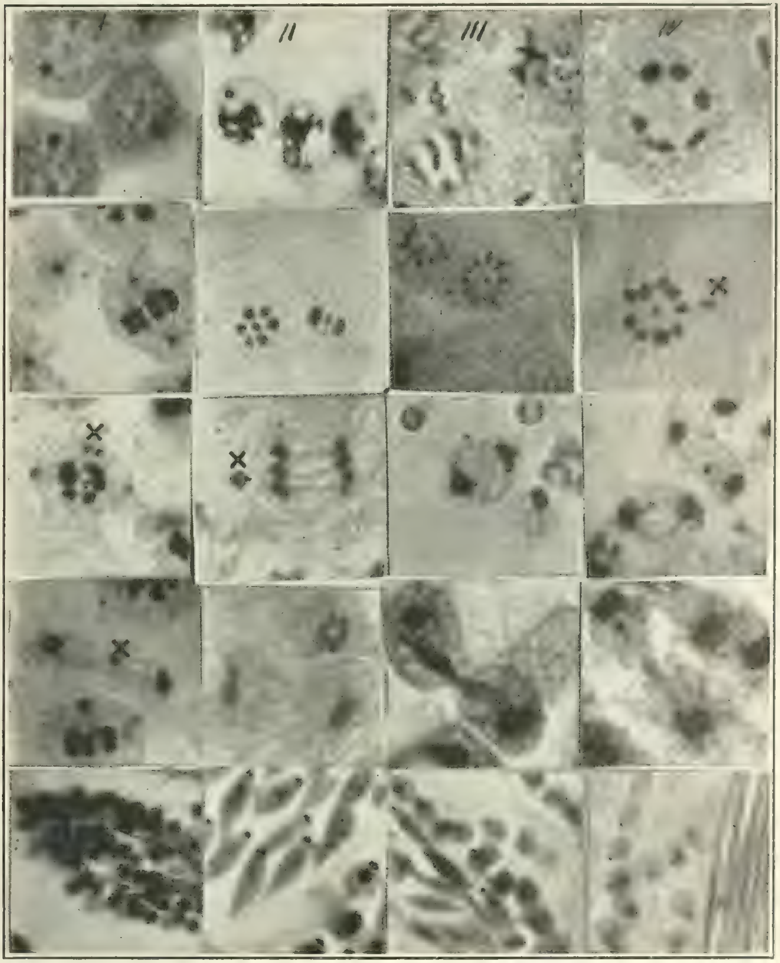
It is a well known fact that all of the higher forms of both animal and vegetable life may be traced back to the union of two cells. In plants, these two cells are designated as the pollen and ovule, in animals, egg and spermatozoon.

We hope to make plain the origin and growth of the spermatozoa of a few common insects by means of the accompanying photographs taken directly from the microscopic slides. The germ cells are early set aside in the growing embryo and are known as primitive sex cells or spermatogonia.

These cells remain dormant till the animal matures. Each cell consists of a nucleus and cytoplasm, as do most cells. The nucleus occupies the center in a membrane of its own.

All resting cells take up stains readily, so that the nucleus may be colored a deep red or black, while the outer layer of cytoplasm may be colored a beautiful green or rose tint. It is by means of these stains that we learn what is taking place during the process of transformation from the spermatogonia to the ripe spermatozoa. What is true of the animal cell is also true of the plant cell. A growing cell must soon divide and produce two. The spermatogonium grows into two spermatocytes; these again divide, forming four spermatozoa, which terminates cell division, so that each primitive cell forms ultimately four spermatozoa.

The nucleus of the growing cell passes through four phases of growth known as the prophase, metaphase, anaphase and telophase. In the prophase, the nuclear material separates into a number of pieces



SUCCESSIVE STAGES IN SPERMATOGENESIS.

First line across top, prophases; second line, metaphases; third line, anaphases; fourth line, telephases; fifth line, spermatids; x sex chromosome.

called chromosomes. The nuclear wall breaks down and the chromosomes arrange themselves in a circle at the equator of the cell. This stage of growth is termed the metaphase, and when viewed from the pole of the cell the chromosomes appear as round or rod-shaped bodies forming a circle.

Each chromosome now divides in half and the halves move toward the poles of the cell, forming the anaphase. The final step is the telophase, when they have reached the poles of the cell. A membrane now forms across the equator and the chromosomes become enclosed in a membrane, thus forming two daughter cells in the resting stage.

The chromosomes have come together and there is nothing to show their identity except in the metaphase, where they vary much in size and shape. One of these has been called the sex or X chromosome because in many animals the male never has this element but the female does. This gives all cells of the female one more chromosome than the male possesses in all of the somatic or body cells.

THE PRACTICAL BREEDING OF "FIRST-EARLY" MARROWFAT PEAS

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To the raising of new types of garden peas there seems no end, but although the list of commercial varieties is now extremely large, it is hardly probable that the limit of improvement has yet been reached.

Year by year patient workers are endeavoring to breed something better than has hitherto been produced, by combining in a new plant the good points of the older ones, and available records show that in attempting to add earliness to the delicious marrowfat or wrinkled-seeded peas, success has been even greater than might reasonably have been expected.

Until the early part of the nineteenth century, the garden peas in general use in England appear to have been of the round-seeded class, but as a result of some experiments in crossing carried out by Thomas Andrew Knight (a former president of the Royal Horticultural Society) one or two wrinkled types were introduced into commerce.

These new wrinkled-seeded peas, although not early nor very large in the pod, possessed a much richer flavor than the old round-seeded kinds, and came to be known as "marrowfats."

Naturally it was not long before other breeders were in the field endeavoring to improve upon Knight's introduction, with the result that many new forms with larger pods and dwarfer habit of growth were brought into cultivation. One valuable feature however which was still lacking in these improved types was earliness. None of

them would mature so quickly as some of the round-seeded kinds, and consequently the delicious marrowfats could only be enjoyed comparatively late in the season.

However, to Sutton's, of Reading, England—whose achievements in peas are so well known—there appeared to be no reason why, by judicious crossing, varieties should not eventually be obtained which combined the large fine pods and flavor of the marrowfats with the earliness of the round-seeded kinds. Accordingly experiments to attain this end were taken in hand, and as a result they were able in 1891 to commence the introduction of a class of large-podded early

TYPES OF PEA PODS.

At extreme left a pod of one of the early round-seeded peas. Remaining pods are types obtained by crossing, and which are as early or earlier in maturing as the early round-seeded pea, and in addition are wrinkled in the seed.

wrinkled peas hitherto unknown in horticulture. The first to be offered was Empress of India. This resulted from a cross between Early Champion (an early round-seeded pea) and Telephone (a main crop wrinkled variety).

A pea which was subsequently made much use of as a parental form was American Wonder. This very dwarf-growing early wrinkled pea was first introduced in America about 1878 or 1879 by Messrs. Bliss of New York and was said to be the result of a cross between Champion of England (a rather late wrinkled-seeded variety) and Little Gem (a dwarf fairly early wrinkled sort).

The American Wonder proved to be earlier than either of its parental forms, and was thought so much of by Messrs. Sutton that they bought up the entire stock intended for England and introduced it into that country in 1881.

Soon after the introduction of Empress of India, came A 1, May Queen, and Harbinger (all being the result of crossing American Wonder with Paragon), and it is interesting to observe that, although these experiments were carried out before the results obtained by Mendel were brought to public notice, it was found necessary, in order to secure fixed stocks, to grow from single plants only—the reason, however, not being so apparent as at the present time.

As time went on seedlings from the crosses were themselves used as parental forms, as also was Gradus (a variety introduced by Laxton and said to be a cross between Earliest of All and Duke of Albany), until, by crossing and recrossing, it has been possible to put into commerce such varieties as First of All, World's Record (both results from Harbinger × Gradus), Ideal (A 1 × Chelsea Gem), Reading Wonder (Harbinger × Gradus), and others, all of which retain not only the large size of pod and delicious flavor of the marrowfats, but have the earliness of the older round-seeded kinds, and in several instances even the earliness of the latter has been eclipsed.

The following table gives the dates on which pods of the parental forms and the seedlings could be gathered, all having been sown on the same day and treated alike:

Parental forms:	
Earliest of All (round-seeded)	June 15
Early Champion (round-seeded)	June 15
American Wonder (wrinkled)	June 18
Gradus (wrinkled)	June 19
Chelsea Gem (wrinkled)	June 20
Duke of Albany (wrinkled)	June 26
Telephone (wrinkled)	June 27
Champion of England (wrinkled)	July 7
Paragon (not now often grown; was a second-early wrinkled pea).	
Seedlings:	
Empress of India (wrinkled)	June 16
A1 (wrinkled)	June 17
May Queen	June 12
Harbinger (wrinkled)	June 15
First of All (wrinkled)	June 13
World's Record (wrinkled)	June 13
Ideal (wrinkled)	June 14
Reading Wonder (wrinkled)	June 15

The late Dr. Maxwell T. Masters, F.R.S., after an inspection of some hundreds of rows of these experiments, wrote in the *Gardener's Chronicle:* "They are very interesting as showing what may be done by crossbreeding and selection when these processes are carried out not haphazard, but with a definite aim in view."

EDITORIALS

THE WOMAN MOVEMENT AND EUGENICS

The world-wide impulse on the part of women to desire the right of suffrage is but a part of the evolution in the adjustment of women in the vocations. Machinery has taken much of women's work out of the home and placed it in the shop and the store. Public education has taken another part into the school. Machinery, improved transportation and other agencies have reduced the number of farmers from two-thirds of the whole population to one-third, and many women who directly and indirectly labored in agricultural production are now in city homes or are employed in non-agricultural vocations. The vastly increased number of vocations and the vastly increased number of people in vocations other than farming and household work, due to the evolution of manufacturing methods, transportation and business, have given openings to women in a multitude of new lines of work. In nearly all cases the work is for wages or salary. Very few women, comparatively, are managers of businesses of their own. And relatively few have professional work of an independent nature.

With the rapid increase of wealth a large number of women of well-to-do families go into the leisure class, producing, often, neither children nor other forms of national wealth. But the great change has been from work in the home, usually the farm home, to work as an employee.

On the whole, women are becoming much more independent of fathers or husbands for support; and in a very large proportion of cases their labor goes to the support of the family, as was the case when women did part of the productive work of the farm. On the whole, the family income is greatly augmented, and the food, the clothing, the housing, the schooling, enjoyable reading matter, and pleasurable social intercourse are greatly increased. The hours are shortened; the physical overstress is greatly relieved; but on the other hand, indoor occupations greatly lessen muscular vigor and doubtless impair genetic vitality.

The new order of things has thrown women more on their own resources and more together. The shop, the store, the school, and especially the wider social life have proven a suitable soil in which to grow up a community of interests. Such discriminations as a lower scale of wage for the same service as given to men, the prohibition of the

right of the ballot, the ownership of too large a proportion of the property by men and unequal rights at law, together with a growing feeling that motherhood is worthy larger rewards, have been the fertilizing elements which are giving growth to the woman movement. It is a part of organic evolution; a centering, a coalescing, a correlating, a coördinating of a very material force heretofore not acting with unity. Its size and importance is comparable with that of the financial interests, the labor unions, the federations of farmers. It is withal wholesome and is destined to succeed in gaining very large results.

Contemporaneous with this stupendous economic, educational, social, and political movement of women is a very strong tendency to reduction of the birth rate; though this is in part counteracted by a lessened infant mortality and by general sanitary conditions and methods which materially prolong the average of human life. The age at marriage is increased; the stress of high living seems to make necessary the absence of very many women from the home so as to help secure adequate family incomes; women work at occupations which soften their muscles and cause them to shrink from childbirth and from the manual labor of caring for children. And those with splendid eugenic heredity, possibly even more than those whose children will fall below average efficiency, use their knowledge to lessen the birthrate.

The ideals of our times—too often promulgated by our schools—which should serve future generations as well as the present generations, have led our women to disregard to too great an extent social values, racial duties, and racial opportunities. Our leaders have been narrow in not teaching women more of the wholesome, vital, and racial points of view of motherhood. Very many women of the very best racial blood have chosen to belong to the girl bachelor class. The philosophy of our times has rather encouraged bright women to choose a successful line of employment, or to repose in the "fine art of idleness" in parental homes, or to lead lives of married sterility. Those able financially, physically, and morally to produce the best children so as to bring up the racial average have been rather content that their sisters with less of material wealth, often not strong physically, and sometimes with lower moral ideals should produce a larger percentage of youth. It would seem that the relatively lower birthrate in the families of the more effective persons, as compared with the higher birthrate of those whose average efficiency is lower than the normal, is on the whole carrying the network of descent, of the nation as a whole, to lower rather than to higher levels.

Possibly it is natural that women should magnify the rights and the opportunities of the individual in the present state of social organization. It must be recognized that they are magnifying the home as never before, especially the physical and mental phases of the home. Whether, even in the presence of greatly enlarged education and with vastly more, better, and cheaper books they are building up the moral and spiritual aspects of home life is widely questioned. They are also taking a far more active part in making the community, the county, the state, and the nation of service to the home. Their movement for suffrage is in no small part a step preliminary to the closer control or perhaps even elimination of the saloon, and the brothel, and even looks toward measures to bring about the abolishment of wars, three great enemies of home and happiness.

The woman movement is marked by great epochal campaigns. Her right to labor in any suitable vocation is nearly won in this country. Among the many other movements that of the eugenic possibilities, opportunities, and responsibilities of motherhood has arisen. It is as yet but poorly defined. No one has as yet become its acknowledged leader, nor has any one defined its principal factors. These are being defined by the modern science of genetics. The breeders of plants and animals, the students of heredity, and those who have made the beginnings of the science of eugenics, the breeding of men, have wrought out many of the scientific facts and a few of the practical factors.

In the large, the problem is so to organize the ideals of people and the economics of the country and the world that the blood with highest eugenic efficiency will become dominant; that the blood with medium value shall be less rapidly multiplied, and that which is least efficient, shall reproduce less freely or not at all. This means that records of the efficiency of all individuals must be kept, and that these records must be compiled into performance pedigrees showing average eugenic values of the members of families, upon which may, with reasonable certainty, be predicated the average probable value of the progeny of each person.

These records will be neither costly nor difficult to make as compared with the value of even small improvements in the heredity of the world's paramount species. The breeders of plants and animals can help formulate practical plans for recording eugenic data and for tabulating and interpreting them. And ere long our most skilled geneticists will be among those who seek methods of improving this most complex and immeasurably the most interesting species.

And once our women shall have gotten past the present foibles

of eugenics and have guided themselves into sane, scientific, and practical lines, they will formulate the largest of all their campaigns. The women will add eugenic science as the largest new addition to their religio-science teaching. And the families of men will come to estimate values in terms of efficiency of grand-children, multiplied into the number in the grand-fraternity group. Then on the one hand eugenic improvements and on the other hand education and other environmental improvements will proceed together in the development of a race of high average sanity, health, and general efficiency.

BREEDING AND AGRICULTURAL ORGANIZATIONS

At the end of the twentieth century, speaking broadly, the United States will have approximately fifty million farm people, who will have the task of growing food for other one hundred fifty million people living in towns and cities or two hundred million all told. About fifty million farmers will be organized into ten million families for the most part on ten million family owned farms.

On the average, about a thousand people living on an area of perhaps 20 to 40 square miles, and comprising about 200 farm families, will be organized into a consolidated school district, each farm sending to school an average of one pupil, these institutions will have each about two hundred pupils. These school districts will eventually serve also as convenient districts in which to organize every variety of country life collective activity, mostly on a coöperative basis. Thus, we will have somewhere near forty thousand country life schools. Each one of these will have a school farm of ten acres to be used in large part in instruction, and in testing new varieties of plants. A county of average size will contain about twenty of these country life school units, organized into a county country life school system.

Ten counties, with two hundred country life school districts, in a number of States constitute a State technological agricultural high school and branch experiment station district. Each of the four hundred of these State technological farmer's schools and stations will, on the average, have five hundred acres of land, or a total of two hundred thousand acres. On its large school farm each agricultural high school will have approximately four hundred students, requiring an annual public expenditure of perhaps thirty or forty thousand dollars, and a branch experiment station with an annual expenditure of ten thousand dollars.

Eight technological school and branch agricultural station districts, in a large state on the average, would constitute a state district

country life school system, articulating with and supplementing the state agricultural college, the State Experiment Station and the State normal school. The State Colleges and the State Experiment Stations will have farms averaging one thousand acres or a total for the United States, of fifty thousand acres.

The fifty State Colleges and Stations will supplement the U. S. Department of Agriculture; whose separate experiment station farms, demonstration farms, forest nurseries, plant introduction gardens and temporary experimental tracts will cover another fifty thousand acres.

Thus 500,000 acres belonging to country life schools, 200,000 to State technological agricultural schools and branch experiment station farms; 50,000 to State Agricultural Colleges and State Station farms; and 50,000 used by the U. S. Department of Agriculture makes an aggregate of 800,000 acres devoted to agricultural research and country life education.

It is not too much to hope that 200,000 acres or one-fourth of this 800,000, will be demanded by public work in breeding plants and animals. And certainly several times this amount of land will be required under private efforts at creative work in plant and animal breeding.

In many species of plants the experts at breeding will coöperate with the superintendents of all three classes of public farms and with many private breeders and plant growers. Whether they be officers of the U. S. Department of Agriculture, of a State Experiment Station or of a branch station, they will be able to coöperate with many stations in testing new introductions or creations and in adjusting them to their proper zonal areas of country in which they will be of service to the farmers. The branch stations and the consolidated rural school farms will offer the large aggregate of opportunity to adjust varieties to the localities where they will be especially useful. The federal and state experiment stations will be able to highly develop methods of breeding in both plants and animals, and will have the means with which to assemble and test the necessary foundation stocks. They will also best be able to develop men highly trained in hybridizing, in seeking out mutations of value, and in building up such recombined networks of descent as will form varieties which prove of highest value to growers of plant and live stock products.

If the Department of Agriculture would expend $2,000,000 annually; the State Experiment Stations $2,000,000; the branch stations $2,500 each, or a total of $1,000,000; and the consolidated rural schools $50 each, or a total of $3,000,000 annually, a grand total of $8,000,000

in breeding and testing plants and animals, and the result would be $200,000,000 increase in our farm products, the national and state governments would thus increase production equal to one-tenth of our total national, state, municipal, county and township public expenditures, each dollar producing twenty-five dollars.

As the man whose fields yielded sixty bushels of wheat groaned because "It is mighty exhausting on the soil," so these figures seem large to the conservative man, who hesitates about making expenditures and groans over public expenditures designed to produce wealth as well as those designed to make war or to pay pensions.

If our plant varieties and animal breeds do contain mutations of large value, as scientists have proven, the work of segregating them and replacing the less valuable forms with new varieties and breeds which have the power to produce ten or twenty-five per cent additional farm products, is one of the largest of our conservation problems. Shall the views of the pessimist and the ultra-conservative prevail, or shall we gradually, and more rapidly, develop plans for using part of the available public experiment and demonstration farms for breeding superior types of plants and animals? If this work is to be undertaken for the whole United States, federal and state plans fitted to the whole area are neither too small nor too large for the project.

RACE GENETICS PROBLEMS

If the amount of space which is devoted to questions of the day in books, and in technical and popular magazines be accepted as a criterion of the importance of any particular subject, eugenics is slowly but certainly approaching the discussion stage; a circumstance of immense importance. And indications are not wanting that the race-social and race-hygienic questions which are being agitated by various reform elements are excellently preparing the ground for the further favorable reception of eugenics as a practical science—a science which comprehends not only the individual and the family, but the entire race.

The fundamental ideas of the application of the same laws of heredity to all living matter, plant, animal or man alike, and of the hereditary transmission of certain traits for good or evil are being received more readily among the intelligent and thinking part of the population, than the pioneer eugenists in their fondest hopes have allowed themselves to believe possible. It appears not at all improbable, nor even visionary, that in fifty or seventy-five years negative eugenics will have gotten a sufficient foothold in race-proud families, in the

statutes of states, and in practical Christianity to have brought under a reasonable degree of control the honey-combing attacks of tuberculosis, neurasthenia, syphilis, and alcoholism, and that small portion, a nucleus, of the white race at any rate, will voluntarily have placed itself under a positive eugenic regimen.

Part of, and most intimately connected with eugenics is the problem of (human) race biology, which in itself covers a field of research of vast extent. The mingling of races, brought about by the white man's own aggressiveness, inventiveness, and desire of conquest and dominion, is reacting somewhat against him. At no time in the world's history has there been in progress such a general mingling of the races of the human breed, over so vast an area, as at present. And it is not a mere over-lapping of nationalities along the border lines of their respective countries, or a matter of one race possessing itself of territory occupied by another, driving it before as it were, each race retaining in the main its pure characteristics. Modern transportation facilities, capable of transplanting in a comparatively short time entire sections of population of one country to another country facilitate race mingling on a stupendous scale.

Speaking especially with reference to the United States, although applicable also to Canada, we have in most unjustifiable and unscientific fashion been assuming that in this great "melting pot" the best qualities of all nations and all races are being run into one great flux from which there would be cast one superior individual—a superman—the American. With optimistic forgetfulness we failed to take into account what was to become of whatever bad qualities there were. Truth is that up to the present, race mixture in its strictest sense had not been taking place. It was negligible because infinitesimally small, and the "American" of today as we have him in mind, is really the result of the unfoldment of the pronounced, inherent, initiative, creative, and constructive traits of the long-light, blond, long-skulled race, under the environments of a new continent with untouched resources, a new soil, favorable climatic and physical conditions. The political, commercial and industrial ventures of this race do not owe their unparalleled successes to a supposed blood mixture, but to qualities acquired and bred into its protoplasm since the stone age. That same race had in earlier periods built up marvelous culture centers in Egypt, India, Greece and Rome. So long as we were compounding English, Celt, Scandinavian, German and Dutch we were merely mingling and regenerating a practically homozygous stock of aryo-germans.

As yet we have too small a scientific basis to make pronounciamen-

tos as to the beneficial effects of indiscriminate race mixture, or, for that matter, of the superiority of pure racial stocks, or of the value of the mixtures of specific races. Together with eugenic research within the species, must proceed research into the origin, inherent peculiarities and genetic and social values of the different racial stocks, and the results of each of the possible crosses. We are allowing race mixture to proceed on a large scale without definitely knowing, for instance, which characteristics of the white, the yellow, and the black breeds are dominant; without having a knowledge of whether certain undesirable physical and psychic characters of other races are not so strongly dominant as to breed out some of the most desirable and distinctive characteristics of the aryo-german race; whether we are breeding to build up or to undermine our own civilization; whether the aryo-germanic race, which took possession of this continent, assumed dominion over it and planted in it its civilization, institutions and ideals, is not in danger of being mixed with the blood of other races to the degree of obliteration if the present rate of influx of immigration from the far east, from southern and southeastern Europe and from Asia Minor is allowed to go on unchecked.

Assimilation has been used as a word to conjure with. But in view of the fact that heretofore we have really been "assimilating" races of kin we do not know the precise assimilative strength of aryogermanic blood. The long-skulled, (dolicocephalic), blond, blue-eyed race is meeting with a tremendous influx of the round-skulled (brachycephalic), generally black-haired and black-eyed race. The final test, which is inevitably approaching, will not consist in assimilating this or that other race but in dominating the complicated net-work of heredity in what threatens to become a blood-chaos.

The Slavs, the eastern branch of the aryo-germanic race, inhabiting what today is Russia, were by origin long-skulled, blue-eyed and blond-haired. Repeated Mongolian invasions have left their inevitable marks and have changed them to predominatingly round-skulls. This much for assimilation.

The sub-races of the aryo-germans which all through history have proved to be carriers of culture and civilization can assure themselves of the continuance of their dominance in world's affairs, and of the permanence and even brilliant expansion of the splendid civilization they have created, by scientifically directing their evolution. A sound eugenic sentiment, backed by race pride and family pride, will be the vital power which will direct that race toward the larger ends. All other races knowing their genetic values can similarly strive for eugenic results, encourage fit and discourage unfit crosses.

NEWS AND NOTES

ZEBU CATTLE RESISTANT TO TEXAS FEVER

The Twenty-sixth Annual Report of the Bureau of Animal Industry, recently issued, contains the following relative to the immunity of zebu cattle:

About thirty years ago a number of the so-called Brahman cattle of India were introduced into southern Texas by A. H. Pierce, a stockman of Pierce, Texas. These animals were crossed with our domestic cattle, and the resulting influence on the herds was markedly apparent. One of the most interesting observations was that their progeny remained relatively free from ticks while other stock in the same pasture would be literally covered with these pests. The cattle ticks are present in such enormous quantities in this section of Texas as to make cattle raising much less profitable than it should be. This is due not so much to the fact that these ticks carry the Texas-fever microorganism as to their great blood-sucking powers as external parasites. The Brahman grade cattle appear likewise to be less affected by other parasites and pestiferous insects such as mosquitoes, hornflies, gadflies, etc., and to withstand better the warm, dry climate and other semitropical conditions present in the Gulf Coast section of the United States than do the native cattle. * * *

The sebum secreted by the sebaceous glands of the skin has a peculiar odor which seems to be repugnant to insect life. The hide, while it may be as thin as in our domestic animals, still appears to be much tougher and is more difficult to penetrate with a hypodermic needle. The hair is quite short and does not provide favorable shelter for the development of ticks. These three factors are probably responsible for the slight amount of tick molestation which these animals experience.

Dr. Farrington, assistant chief of that bureau, in commenting on that statement, says:

It has recently been reported to this office that the descendants of the 1906 importation have proved, and are proving, fully as resistant to the Texas fever ticks as the members of the earlier importations, and in consequence acquire a larger growth, and are always in superior condition and thrift.

There were 33 animals in the importation of 1906, and at the present time half-blood and three-quarter-blood descendants in large numbers have been carefully observed, and all have proved very satisfactory in their resistance to infection with Texas fever.

Mr. A. P. Borden, of Pierce, Texas, the leading authority on these importations, says that every year proves more conclusively the desirability of crosses between the cattle of India and our common cattle from west Europe as producers of live-stock products in Texas and the Southwest generally.

ORGANIZATION OF A FRUIT REGISTRY ASSOCIATION

An organization known as the American Fruit Registry Association has been established with headquarters at Sunnyside, Washington. Mr. H. M. Lichty, secretary. The purpose of this organization is to secure scions from mother trees of the different varieties of fruit which by actual test are known to have been prolific yielders. This association makes the assumption that there is sufficient bud variation among the trees of a given variety of apple, for example, to make profitable a selection of scions from the few very prolific trees. So far as we know, this is the first time such an assumption has been put into commercial use by an association.

It may be that bud variation does occasionally occur in a way sufficiently marked to justify making of it a material commercial factor. In other words, there may be an occasional mother tree from a bud which, like the mutating seedling plant, has a combination of characters of value peculiarly higher than its fellow trees.

In any event, this association will be able thus to secure wholesome scions and stronger trees. If persisted in, this plan should soon develop whether there is an occasional mutating mother plant from which cuttings can be secured which in turn will produce trees higher in value than the average of the variety.

An effort should be made by the scientists who are studying practical methods of breeding to collect and collate the data which will become available from the work of this association. Selection made in the manner proposed would have been looked upon several years ago as practically ineffective or it would have been held that the selection is in so narrow a range that improvements would not be sufficient to cover the expense.

This company has got out a scheme of blanks and certificates under which they give a sort of pedigree certificate of stocks from mother trees. Should the fondest hopes of these people be realized they will probably be able to give to scions from stock which proves heavy-bearing some form of advanced registration status, as is now done in stock breeding.

THE SUGAR-BEET INDUSTRY IS BASED ON BREEDING

Perhaps the most striking instance of a great industry resulting from the efforts of the plant breeder is afforded by the sugar-beet industry.

Vilmorin and other early plant breeders in France took the common beet and through breeding and selection succeeded in increasing its percentage of sugar from 6 or 8 per cent to 12, 15, or even 20. But alongside of its composition in sugar content they also developed the crop yield so that the yield per acre of sugar was sufficiently large to make the production of sugar by means of this plant profitable.

According to preliminary census returns, there were produced in the United States, in the calendar year 1909, 1,003,400,000 pounds of beet sugar, worth at wholesale $45,938,000. According to commercial estimates there were produced in Europe and other countries, in the crop year 1909–10, 13,532,000,000 pounds of beet sugar, a total of 14,535,400,000 pounds. The magnitude of the beet-sugar industry is indicated by a comparison of the beet-sugar output with the total sugar produced in the world from other sources, as follows: There were produced in the United States in the calendar year 1909, of cane sugar, 668,200,000 pounds, according to preliminary census returns, and in the crop year 1909–10, for the rest of the world, 17,823,000,000 pounds, according to commercial estimates. There was in addition produced in the United States, of maple sugar, 11,928,770 pounds in 1909. Thus, beet sugar constituted 60 per cent of the crop in the United States in 1909 and about 43 per cent of the sugar crop of the rest of the world in 1910–11.

From the agricultural standpoint, beet-sugar growing has the additional value of inducing intensive cultivation and of getting the land in good tilth for other crops.

A VARIETY OF CORN BRED SPECIALLY FOR ELEVATED REGIONS

Mr. A. Jay Garrison, member of the American Breeders Association, of Edgewater, Colorado, has been for many years an outdoor student of the science of breeding as applied to both plants and animals. He is a very successful breeder of poultry with respect to quality, and as a plant breeder he has originated a number of valuable plums.

The corn shown in the photograph is the result of three crosses in six years, starting with Cory sweet corn and a local semi-dent, low-growing variety known as Pike's Peak. The result of each cross was bred back to the Pike's Peak to preserve and intensify the low-growing habit of this strain. And the constant tendency from this breeding has been for the ears to appear lower on the stalks, a necessary

characteristic of corn to be grown in a dry and elevated region. Another tendency was the increasing percentage of stalks bearing two ears to the stalk.

The original ears of Cory and Pike's Peak averaged 6 inches in length. The average length of the ears of the first cross was 8 inches, and that of the two ears shown is 12 inches and 11, respectively. The length of the stalk is 55 inches.

The seed was planted June 10, and the corn was cut September 9. The season was unusually dry and irrigation water scarce, and this corn was grown without irrigation or cultivation.

The variety promises to be of great value for dry and elevated regions like that in the vicinity of Denver.—LEVI CHUBBUCK, *Denver, Colo.*

A EUROPEAN ESTIMATE OF THE AMERICAN BREEDERS ASSOCIATION

In an address delivered in Vienna, Austria, before the Society for the Diffusion of Knowledge in the Natural Sciences, Professor Dr. Erich von Tschermak reviewed the "Experimental Work in Modern Problems of Heredity as Carried on in North America."

The work of Castle, Morgan, Davenport, Tower, Shull, MacDougal, Webber, Williams, Hansen, Burbank and others is mentioned in connection with the work each of these men have done. At the close of this address, Dr. von. Tschermak pays to American breeders a tribute which is as generous in spirit, as it is surprising in frankness. Coming from a European scientist of note his remarks are significant and it should be gratifying to every member of the American Breeders Association to be affiliated with an organization which has been instrumental in advancing genetics in its every phase. He said: "The picture which I have here hastily sketched shows a truly astonishing developemnt of this modern science of genetics, in North America. With youthful energy, which perhaps at times had a too narrow specialism, American researchers have accomplished much that is highly to be commended in science.

In order to hold even honors in future with the scientific accomplishments of her American sister, our European biological science must follow her progress with attentive care and strive for the possession of similar generous equipments for research. Experimental biology has actually, in part, become an American science. Europe must put forth most strenuous efforts not to be completely distanced."

A Corn Bred for Elevated Regions.

A DAHLIA AND GLADIOLUS SOCIETY ORGANIZED

An event of interest to plant breeders is the organization, in Chicago on August 5, of the "Western Dahlia and Gladiolus Society." This society starts out energetically by announcing its first meeting and flower show on September 26 in Indianapolis, Indiana. The second flower show will be held in Chicago next year.

The society is inviting members from among those interested in the culture of these two specialties. The officers of the society are: E. T. Burns, (A. B. A.) Spencer, Indiana, president; W. W. Kauner, Milwaukee, Wisconsin, vice president; W. K. Fletcher, Des Moines, Iowa, treasurer; E. C. Thompson, Benton Harbor, Michigan, secretary.

PUBLICATIONS RECEIVED

DIE PRÄRIEN IN ZENTRALNORDAMERICA UND IHR WERT FÜR FORST KULTUR. Dissertation prepared for degree of doctor of philosophy at the Ludwig Maximilian University in Munich. Hugh Potter Baker (A.B.A.). 10 illustrations.

PROCEEDINGS OF THE SOCIETY FOR HORTICULTURAL SCIENCE, 1910. Seventh Annual Meeting. C. P. Close, secretary. 89 pages.

KREUTZUNGSUNTERSUCHUNGEN AN HAFER UND WEIZEN. H. Nilsson-Ehle. Lund, 1909. 122 pages.

UEBER FALLE SPONTANEN WEGFALLENS EINES HEMMUNGSFAKTORS BEIM HAFER. Reprint from Zeitschrift für Induktive Abstammungs- und Vererbungslehre. 1911. Vol. V, Heft I. H. Nilsson-Ehle. 37 pages, 2 plates.

UEBER ENTSTEHUNG SCHARF ABWEICHENDER MERKMALE AUS KREUZUNG GLEICHARTIGER FORMEN BEIM WEIZEN. Reprint from Bericheder Deutscher Botanischen Gesellschaft. 1911. Band XXX, Heft 2. H. Nilsson-Ehle. Pp. 56–69.

THE OSTRICH INDUSTRY IN THE UNITED STATES. A. R. Lee. Reprint from Twenty-sixth Annual Report, Bureau of Animal Industry, U. S. Department of Agriculture, 1909. 12 pages, 3 plates.

BREEDING HORSES FOR THE UNITED STATES ARMY. A. D. Melvin, Chief of Bureau of Animal Industry, U. S. Department of Agriculture, 13 pages.

UEBER DIE EXPERIMENTELLE BEARBEITING DER MODERNEN VERERBUNGSFRAUGEN IN NORDAMERIKA. Prof. Dr. Erich v. Tschermak. 26 pages.

UEBER DIE VERERBUNG DER BLUETEZEIT BIE ERBSEN. Prof. Dr. Erich v. Tschermak. 24 pages.

BEWERTUNG DER ZWEIZEILINGEN BRAUGERSTE IN NORDAMERIKA. Prof. Dr. Erich v. Tschermak. 10 pages.

ASSOCIATION MATTERS

YEARBOOK OF PROCEEDINGS OF THE "A. B. A." FOR SALE

The Secretary's office has on hand a number of copies of Volumes IV and VI which as customary, will be sold at $2 per volume. Back numbers of Volume I of the *Magazine* will be furnished with Volume VI of the Proceedings until the supply is exhausted.

The members of the Association are requested to assist the Secretary in selling some 500 copies of Volume VI. The Association has considerable funds tied up in these yearbooks and it is desirable to realize on at least part of them. A liberal allowance has been set aside to meet possible demands from newly entering members, leaving several hundred for sale to individuals, libraries and institutions. Members are requested to do some lively and energetic work in placing these publications in public libraries, and those of colleges and universities.

If only a very small fraction of the 30,000 public libraries regularly carried our publications on their shelves the four or five hundred copies which we can spare would soon be disposed of.

It should certainly be an easy matter to induce your local public library to purchase these Proceedings regularly. Besides this, we would gain another object, namely, that the propaganda of the American Breeders Association would be brought more fully before the public, and our publications would do the missionary work which in part they are designed to do.

NEED OF GREATER PUBLICITY

One of the pressing needs of the Association is publicity. It is needed to attract new members. The Association must be kept in a state of expansion and vigorous growth.

Publicity is also needed in order to make the propaganda of the Association fully effective. We know that what we advocate regarding the improvement of the plant and animal resources of the world by breeding is sincere and sane, and we should let the world know it. We know that our advocacy of eugenics research and of a eugenics program is rational and sound, and we should therefore place ourselves in a position where we can command the attention of the thinking part of the population of this and other countries. The American Breeders Association can be made to be widely known if its members

will frequently, persistently, systematically, and on every possible occasion mention its objects, its work, and its publications in the circle of friends, in the lecture room, or in public meetings, and in the press.

REPORT OF THE SECRETARY OF THE COLORADO STATE CHAPTER

During the early part of the present year several of the Colorado members had some conversation regarding ways and means of promoting the interests of the plant and animal breeder, and at this conference it was suggested that something might be gained by organizing a state chapter or section for the purpose of getting the Colorado members together at two or perhaps more meetings during the year. At these sessions special problems relating to the improvement of fruits, farm crops, or live stock could be discussed and it was thought that in this manner our members would get better acquainted with the development of different phases of this subject in the West. This in turn would lead to a more careful study of the plans which have been evolved in other sections of the country under the direction of the parent organization.

On February 22, a meeting was therefore held at which twenty-one men were in attendance. The plan in question met with hearty approval from every member present, and a committee of three was appointed to draft a constitution for the guidance of the proposed new chapter. Several of these men were not members of the American Breeders Association, but when the objects of the society were explained a number immediately requested that their names be placed on the membership list of the national organization and promised that they would lend their assistance in promoting the welfare of the local chapter. This attempt to get our men together has resulted in additions to the American Breeders Association, and we have every reason to believe that many more names will be sent in before the end of the year.

Our second meeting was held on the evening of July 3. The entire time was spent in discussing the constitution which was prepared by the committee. During the busy summer season it was not possible for us to plan for another session, but we hope to be able to report rousing meetings early in the autumn and winter months. -L. A. MOORHOUSE, *Secretary, Colorado Chapter, A. B. A.*

EIGHTH ANNUAL MEETING
1911-12
AMERICAN BREEDERS ASSOCIATION
WASHINGTON, D. C.

December 28–29–30

At the new Masonic Temple, corner 13th Street and New York Avenue, N.W. General sessions 11:00 to 12:30 daily, and 8:00 to 10:00 p.m. on December 28 and 29.

Plant Section meetings, Assembly Hall, 9:00 to 11:00 a.m. and 2:00 to 4:30 p.m. daily.

Animal Section meetings, North Hall, 9:00 to 11:00 a.m. and 2:00 to 4:30 p.m. daily.

Eugenics Section meetings part in South Hall, part in St. Elizabeth's Insane Hospital and part at the Volta Bureau, 35th Street and Volta Place, Georgetown. For further data see final program.

Hotel headquarters; room 214 Raleigh Hotel. Single rooms $2.00 a day and up; single rooms with bath, $3.00 a day and up. Double rooms, $3.00 a day and up; double rooms with bath, $4.00 a day and up. *Rooms should be reserved at once.*

Please send titles of papers before December 10 either to the section secretaries (H. J. Webber, Plant Section, Ithaca, New York; C. B. Davenport, Eugenics Section, Cold Spring Harbor, New York; H. W. Mumford, Animal Section, Urbana, Ill.), or for general committees, to the Secretary of the Association, W. M. Hays, Washington, D. C.

Railroad rates: In paying your fare to Washington, request a certificate. If the station agent has no blank certificate, buy ticket to nearest town where certificate can be secured and then buy ticket and secure certificate. On arriving in Washington, present your certificates to Mr. F. S. Hazzard, assistant secretary of the American Association for the Advancement of Science, office of permanent secretary, New Willard Hotel. Write Mr. F. S. Hazzard, Smithsonian Institution, Washington, D. C., for more detailed information concerning transportation and for lists of more than thirty affiliated societies which meet in Washington during holiday week.

For program and other information concerning the American Breeders' Association, write to W. M. Hays, secretary, Washington, D. C.

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Albrecht Daniel Thaer

THE AMERICAN BREEDERS MAGAZINE

"To the solid ground of Nature trusts the mind which builds for aye."—WORDSWORTH

Vol. II Fourth Quarter, 1911 No. 4

ALBRECHT DANIEL THAER

1752–1828

Ideas grow at a painfully and almost discouragingly slow rate. The only people whom nature seems to have fitted to nurse ideas with becoming patience and optimism are reformers and scientists.

Our modern science of plant breeding dates back to an idea which was born in the mind of the botanist Camerarius, who in 1694 published a work "De sexu plantarum epistola" in which he cites a series of experiments to prove the nature of sexual reproduction in plants. Camerarius, by the way, was the first scientist to resort to experiment in his search for facts. In this case he worked chiefly with maize and castor beans. About 1760 Koelreuter, professor of natural history at a German university, for the first time successfully hybridized plants, and thus established beyond a doubt not only the sexuality of plants but also that in all essentials they are subject to the same laws of reproduction as animals. Other scientists continued Koelreuter's work, notably Gaertner and Sprengel, but the idea of the sexuality of plants remained housed within the precincts of the savant's studies and laboratories and did not find its way into practical application in agriculture until about the end of the eighteenth century. The man whose vision was clear, and who knew how to make the laboratory knowledge dynamic, was Albrecht Daniel Thaer. He has variously been called the "great agricultural reformer" and the "grand-master of agriculture" and the like, in recognition of the fact that he laid the foundation of the scientific agriculture of today. Among the diverse interests of his active and crowded career, the importance and possibilities of plant breeding did not escape his attention.

Thaer was born in the town of Celle, in the province of Hanover, Germany, the son of a physician. After a study of medicine at the University of Goettingen, he associated with his father in practice and continued alone after the death of the latter. In 1786 Thaer purchased a suburban residence with eight acres of ground, which he immediately began to cultivate intensively. He had noticed the

shortcomings of the farming done by farm owners of the country surrounding Celle and in the province generally. He saw lack of rational farm management; lack of intensive methods; employment of an excess of hand labor owing to lack of machinery suitable for the use of horse power; too much reliance on fallowing; and practically no crop rotation. The aim he set himself was to make a practical demonstration that farming was nowhere more satisfacfactory and remunerative than on the lands near Celle. In 1804 he removed to Möglin near Berlin and founded the Möglin Agricultural Institute. Once there, he vigorously promoted his plans, and brought the German farmer to his viewpoint and taught him how to apply science to farming. This farm, which had really become a demonstration farm, was the gathering place of many men in quest of agricultural knowledge.

Albrecht Daniel Thaer's mind was immensely productive. He contributed voluminously to agricultural literature, wrote text books on a variety of farm subjects, proposed a soil classification, introduced soiling or stall feeding of cattle, promoted vigorously the growing of red clover and other legumes.

In his gardens at Celle he conducted numerous breeding and hybridization experiments, and his insight into the nature of the processes of breeding and selection seems to have been truly remarkable; in some of his deductions he was fully abreast of our most modern views. He knew well the value of fortuitous variations and the part they play in the origination of new varieties. He very minutely describes in one of his publications a method of breeding through selection to secure constancy of type. He conducted breeding experiments with the view of learning the behavior of the awns of small grains, their variation and constancy, and the possibility of removing them by breeding.

HEREDITY AS A FACTOR IN THE IMPROVEMENT OF SOCIAL CONDITIONS[a]

H. E. JORDAN
University, Virginia

Those of you who have followed recent thought respecting human society will readily assent to the statement that there appears to be urgent need for improvement. Perhaps some of you in following the

[a] Abstract of address delivered by Dr. H. E. Jordan before the Virginia State Conference of Charities and Correction, Charlottesville, Va., May, 1910.

discussions concerning jails, insane asylums, almshouses, hospitals, reformatories, and public schools have been aroused for the first time to a sense of something fundamentally wrong and unjust. If not even yet, then walk with me the streets of your own city—or any city, large or small, east, west, north or south—with discerning eyes and sympathetic hearts, and note the number of poor, sad, sick, crippled, feeble-minded human beings, and tell me honestly whether you think that all is well, and that you of health, hope, brawn, brain and means have done your full duty towards your fellowman, present and *to come*. What intelligent effort are you seriously making to render life a little less aimless in your small sphere of influence? Are you thinking of these matters at all, or are you simply thoughtlessly "drifting down the turbid stream of life and helping to make up the grand confusion"?

With criminality (Dr. Austin Flint), pauperism, degeneracy, idiocy, insanity, and the various forms of maladjustment apparently on the increase, it becomes incumbent upon the patriotic, and the strong and intelligent, and especially those in positions of trust, influence, and responsibility to use every means, to search every resource, to make any sacrifice, and to go to any reasonable extent to ameliorate, and if possible to eradicate, this human woe; and to save to the future race what long ages of evolution from brute to man, through a bloody struggle for existence, and the survival of the physically, morally, and mentally most fit, has painfully brought to pass. And every one of us can wield some little influence, the cumulative effect of which will bring us nearer the goal of a universally rational and joyous life.

Lest you doubt me still respecting the reality of widespread human misery, come with me hastily in fancy to the insane asylum at Petersburg and the State Hospital at Staunton, Va., the Eastern Penitentiary at Philadelphia, Bellevue Hospital in New York, the municipal eleemosynary institutions on Blackwell's Island, Hull House in Chicago, the dives of San Francisco, the slums of Boston, the cemeteries of this land crowded with infants' tombstones—and I might extend the list almost indefinitely—and tell me again whether you think that the ills of society are imaginary. Remember, also, that the number of the above institutions is increasing, and that their walls are ever filled, and that the ranks of their inmates are recruited anew every generation.

To emphasize still further the seriousness of the present social condition, before passing to a consideration of its cause and suggestions for improvement, let me cite a few facts based upon statistics.

And I shall have to speak in plainest terms. This is no time nor occasion for prudery; to shut our eyes to revolting conditions is nothing less than criminal. The conditions exist. Purity and strength and wisdom, allied with initiative, insistence, persistence, courage and patience, must grapple with the social monsters—vice, crime and disease, the enemies of race improvement. In the United States today 3,000,000 persons are constantly ill. About 10,000,000 are thus economically affected more or less directly. There are now living in the United States about 8,000,000 people—a number equal to the population of the State of New York—destined to die of tuberculosis, and about half that number of Bright's disease. About 50,000 persons die annually in the United States of typhoid fever—a condition which should no longer be listed among diseases, but rather among crimes. About 1 in 500 of population in Europe and America are epileptic; about that same proportion feeble-minded, i.e., about 150,000, and nearly as large a proportion insane. There are 14,000,000 male adults under the age of thirty in the United States, 5,000,000 of whom have venereal disease or its sequelæ. And, saddest fact of all, more than 75 per cent of the operations required for inflammatory diseases in women are said to be due to venereal infections. The hereditary effect in terms of weakened constitutions, congenital infections, sterility of otherwise noble stock—to say nothing of the physical and mental anguish entailed—is appalling. There are in the United States 110,000 blind persons, about 25 per cent of whom owe their blindness to venereal disease; and about 50,000 deaf persons. Hereditary syphilis is said to claim a mortality of from 60 to 80 per cent. In France 20,000 children, or $7\frac{1}{2}$ per cent, die annually of syphilis. In the United States about one-third of all children born die before the fifth year. There are, besides, 80,000 prisoners and 100,000 paupers. In fact, about 5 per cent of our population is seriously defective in some form or other.

I regard this problem of human welfare (really the problem of race improvement) as the cardinal interest of the day. Despite her mines and waterways, all her forests and fertile fields, her navy and her hoards of gold and silver, this nation is rich only in proportion to the health and abundance of her potential fathers and mothers. The only real wealth of this country, or any country, is her citizens. If they be generally poor or sick or feeble or distressed, the nation is decadent and must disappear in spite of material assets. I take it that the most vital concern of this nation is the health of her people. "The health of our pigs has representation in the Cab-

inet, but not our children," says Warbasse. God cares no more for us than for other nations. Unless we would follow the fate of Assyria, Persia, Babylon, Egypt, Greece, and Rome, we must bestir ourselves and apply sane scientific principles to the treatment of our social ills. Dr. G. A. Doren, of the Ohio Institute for Feeble-Minded Youth, warns us that, "Unless preventive measures against the continuously progressive increase of defective classes are adopted, such a calamity as the gradual eclipse, slow decay, and final disintegration of our present form of society and government is not only possible, but probable."

I propose to consider, then, criminality, degeneracy, insanity, and sickness and early senility from the standpoint of heredity. It will be my effort to impress upon you the thought that criminals and degenerates and weaklings are born, just like poets, and not generally made by their environment. I believe I shall be able to show you that insanity is heritable and that feeble-mindedness and epilepsy sustain an etiological relationship to drunkenness. And the evidence is overwhelming that many forms of disease, or a predisposition or susceptibility thereto, at least, are traced from ancestor to offspring.

If it can be shown—and there seems little doubt on this point—that many types of human defect are heritable, the prevention of a steady quota of deficients is well within our power if we will. The positive aspect, of course, pertains to the inheritances of good qualities and plus racial characters. Where doubt exists or where proof is not yet conclusive, government aid could do inestimable service—and only so can the disputed points be quickly and at the same time accurately settled.

All life is conditioned by the same fundamental laws of nature. It would seem, then, that the same methods that man now employs in producing a high quality breed of dogs, or birds, or cattle, or horses, he must apply to himself. What inherent indignity to man is there in this thought? Whence and by what authority is it given that man can violate with impunity the laws of heredity as regards the reproduction of his own kind, but must adhere to them in the rearing of live stock? Why is the subject of race culture tabooed in so-called polite society? There is no issue so vital to this nation today as the rearing of the human thoroughbred. Whence this idea of impurity about this most vital interest of this people, except from the impure or possibly misinformed minds of perverted natures? St. Paul reminds us that "to the pure all things are pure."

It would be extremely interesting and might prove very instructive to trace the origin of the idea so intimately associated with our reli-

gion that the body is inherently base, that it must be "mortified," that it is something to be despised, that only as the body is neglected can the soul arise. I know not whence this idea. I know only that the author of our religion said that He came that "they (His brethren) might have life and that they might have it more abundantly." True Christianity gives no warrant for this exaltation of a weak and listless body.

It is just possible that much of the admitted loss of grip of the church on the conduct of virile men is due to the fact that religion today is shaped too much to make its especial appeal to the sick and unfortunate—too much of its assumed authority issues from mental and physical weakness. I hope I may not be misunderstood here as to my feeling regarding the efficacy for good of religion. It is unmistakably one of the greatest moral forces in existence. But I hold that the healthy man can best express the highest type of religion. We want religion to appeal to strength and to health—and we want it to help in the effort to restore racial health, somewhat perhaps as the Emmanuel movement, in a very small way, in its inception. Religion to appeal more universally must become suffused with modern biological teaching. It must exalt health and bodily vigor more as something to be prized and respected. Its new spirit must teach that it is as important a matter to observe strictly the laws of personal hygiene as to say prayers. Perhaps when the span of life shall have become lengthened preparation for the ministry will embrace medical training and the physician's calling theological instruction. At any rate, we may expect religious teaching to take more serious and intelligent note of the laws that underlie life and the making of life and perhaps teach right conduct toward the future race as a part of the morals of religion.

Right-minded men are not willfully bad. Ignorance is at the root of much so-called vice and crime. An intelligent understanding of the laws of heredity and reproduction would do more toward minimizing vice than much impersonal religious teaching. The public schools also can do a splendid work here in dissipating harmful ignorance and foolish sentimentality by giving well-planned courses in botany and zoölogy.

It is an established fact that the degenerate class are more prolific. The fecundity of the irresponsible is frightful. Under such circumstances the deficient types will swamp the better types and thus lower the human standard and the general level of our civilization.

To return after this slight digression to the condition of our main interest: Any living thing is the product of an interaction between its inheritance and its environment. A discussion of the relative values in development of heredity and environment would be senseless. Both heredity and environment are essentials; essentials cannot be compared. The best stock of inherited qualities in an unfavorable environment produce nothing; nor can an ideal environment produce anything without a germ of life representing an inheritance. A noble man is not born from fools, no matter what the environment provided. Figs do not grow on thistles nor grapes on thorns in any environment. A feeble-minded child cannot develop into a great scholar even in an ideal environment; and, vice versa, one inclined by heredity toward the life of a scholar cannot become such in an unfavorable environment, nor can one born an athlete excel in sports if bred in an environment that does not call forth the exercise of his talents.

I do not want to rob the human heart of the commendable virtues of pity, sympathy, and charity. I do not want to see done anything less than we are now doing for the comfort and happiness of our defectives of various types. I want to see material conditions improved for all classes alike to the highest degree possible. But for the sake of the future race, for the sake of the light entrusted to our civilization, out of respect and honor to our intelligence and good sense, let us have the courage to recognize our duty and forbid parenthood to the proved, and universally admitted, unfit. We speak of improving the condition of the jail, almshouse, insane asylum, etc. That is well. But don't you see that their inmates continually pass out, while their places are continually taken by new recruits? What I hope for is a condition where jails and asylums and charitable institutions are unnecessary. And I hope I shall be able to show that such a desire is not as quixotic as it may at first appear. These public institutions are a fearful drain—the more so because unnecessary—upon the national resources. They represent, moreover, a waste of much valuable time and effort. Our 42 institutions for feeble-minded cost us \$5,000,000 annually; our 350 hospitals for insane, \$20,000,000 annually; our 1,300 prisons, \$13,000,000 annually; our 1,500 hospitals, \$30,000,000 annually; our 2,500 almshouses, \$20,000,000 annually; and our 115 schools and homes for deaf and dumb, and our 1,200 refuge homes, cost us many millions more annually. ("Eugenics," Davenport.) The time is fully ripe for at least negative eugenics—i.e., the prohibiting of parenthood to the unfit.

I am not yet persuaded that recourse to surgical procedure is the best alternative, except in most extreme cases of hereditary degeneracy; but I do advocate—and there can be no objection to this measure—that the inmates of our institutions for deficients be detained, no matter what temporary improvement they may show, until after the procreative period. This much at least is clear: that to be permanently rid of deficients, they must be prevented from reproducing their defective kind. Our only hope for racial improvement lies in prohibiting the continual replenishment in frightful numbers of our degenerate and criminal classes.

Professor Irving Fisher predicts that "laws like that of Indiana, but of gradually increasing severity, will become quite common in the future;" and Prof. Ray Lankaster has remarked that "humanity will probably submit in the future to communal restricting of the right to multiply with as good grace as it has given up the right to rob and to rape." The possibilities of applied eugenics are indicated by Prof. Louis R. Ehrlich, in the statement: "How rapidly the race would advance if mankind should resolve 'the next generation must be born with healthy bodies; must be nurtured in healthy physical and moral environments, and must be filled with the ambition to again give birth to a still healthier, still nobler generation'" (p. 54 of Prof. Fisher's report). Note also the sad commentary of our business sense— not to mention our moral sense—in the words of Dr. Prince Morrow of New York: "The extermination of social diseases would probably mean the elimination of at least one-half of our institutions for defectives." "So definite and certain is the result of the marriage of two imbeciles, and so disastrous is reproduction by an imbecile under any conditions, that it is a disgrace of the first magnitude that thousands of children are annually born in this country of imbecile parents, to replace and probably more than replace, the deaths in the army of about 150,000 mental defectives which this country supports." ("Eugenics," Davenport, pp. 14–16.)

Criminals, paupers, degenerates, the incurably sick and their kind are a serious burden—in cases even a menace—to society. Society has a right, even an obligation, to protect itself. The course of action is clear to the extent that in cases of undoubted ability to transmit defects such transmissions must be prohibited. Public sentiment will do much in this direction. Proper instruction will help; here as elsewhere, knowledge is power. Moral suasion on the part of the church and social institutions (lodges, etc.) will not be without reward. Courses in heredity and applied eugenics in our

medical schools and training schools for social service are urgently demanded. A national department of public health, from which may issue the results of scientific research and mature reflections—and which would coördinate all the branches of social service—is indispensable. And it is especially demanded that every one do his share of serious thinking and have the courage to act positively or negatively in the interests of the future race; and where all other means fail of appeal, law must enforce eugenic conduct.

The means of race conservation and improvement—the prime end for which social conditions are sought to be improved—seem clear. Simple observance of the laws of heredity and enforcement of eugenic principles would cure many of our social, political, and economic ills. What sanitary science and hygiene seek to accomplish by attention to external conditions alone largely defeats its own ends by counteracting the working of the principle of selection. Moreover, this is a tedious, long-drawn out, painful process. Rigidly applied eugenics would accomplish the end in several generations. The resulting healthy, happy race would require, and, indeed, could compel a still more purified environment. Contemplate this ideal state of human society! Thoroly healthy bodies could develop the highest ranges of mental capacity. There would be little suffering, weakness, sickness, crime, or vice. Individuals showing such tendencies would be treated with more than ordinary kindness and solicitude, but they would be denied the opportunity of reproducing their kind.

Flourence, a French scientist, who has given much attention to the question of old age, holds that an animal ought to live—and may live—five times as long as its period of growth. The natural lifetime of a man should thus be 125 years. Metchnikoff, another French scientist, also believes that there is no inherent necessity in human protoplasm to die short of the century mark. It may be a legitimate question to ask whether long life is really desirable. I believe it is, and, more than this, I believe that human progress in the perfected society above pictured necessitates a longer life. Even today it takes a man from 25 to 30 years to really prepare for life; and the stock of formulated knowledge is ever increasing. There remains too short a period for the use and development of this knowledge, and for the satisfactory exercise of one's powers and the proper rearing of one's kind. Few men ever naturally come to the sense of yearning for death as a boon—i.e., as the natural end to a satisfied life. To quote from Metchnikoff: "Old age, at present practically a useless burden on the community, will become a period of work valuable to the com-

munity, as the old man will no longer be subject to loss of memory or to intellectual weakness. He will be able to apply his great experience to the most complicated and the most delicate parts of the social life." ("Nature of Man," p. 295.) We may predict that when science occupies the preponderating place in human society that it ought to have, and when knowledge of hygiene (and, the writer may add, heredity) is more advanced, human life will become much longer and the part of old people will become more important than it is today." ("Prolongation of Life," p. 226.)

In the race that lives according to natural law and by eugenic principles, birth and death and their attendant pains and sorrows will not be permitted to follow each other in such quick succession. There will be less quantity and better quality. There will be no such ruthless wastes of human effort and strength as now prevail. To be parent to five children, for example, and bring only one to normal maturity, will be accounted criminal to *some one*. This may seem utopian. None of us will live to see this day. But by all the signs of the times, this day is coming. What seems certain is that it ought to come—and come it will as one of the sequelæ to proper social conduct. And it behooves us as intelligent, moral men and women to do our share and add our quota to hasten the time of this life more abundant in this kingdom of heaven on the earth.

CLASSIFICATION OF THE HORSE

PERCIVAL HICKS

North, Virginia

I propose in this paper to discuss briefly that classification of the horse which seeks to show that our modern horses are derived from four distinct species, a conclusion with which I cannot agree, and to set forth my reasons for dissent.

In dividing the existing breeds or families of horses into four species distinguished from one another by slight anatomical differences, and assigning to each a more or less clearly defined geographical area I think scientists have lost sight of much valuable information which has quite as strong a bearing upon the question, as those peculiarities which are regarded as distinctive. To clear the way to a discussion of this question I will at once introduce a diagram of the classification mentioned.

PREJEVALSKY HORSE

1. Callosities on all four legs.
2. Cat hammed.
3. Head set at right angles to the neck.
4. Red-brown in color with "mealy" nose.

CELTIC HORSE

1. No callosities on the hind legs.
2. Black stripe down the back and across the shoulders.
3. Sometimes transverse bars on the legs.
4. Dun color common.

FOREST HORSE

1. Head long and narrow, and set at right angles to neck.
2. Eyes recessive.
3. Has in common with the foregoing generally 6 lumbar vertebrae.

AFRICAN OR ARAB HORSE

1. Head set at an obtuse angle to the neck.
2. Slight difference in the development of the ulna.
3. Has only five lumbar vertebrae.

It would seem from a study of the foregoing that the first and most important distinction is the number of lumbar vertebrae. If it can be established that the present run of horses in use in Arabia and Northern Africa have in all cases only five lumbar vertebrae while other races have six, a large and well defined division would at once be established, but I would very much doubt whether this has ever been sufficiently proved to warrant its universal application and furthermore, I doubt the wisdom of establishing a species upon anatomical differences so subject to variation as the number of vertebrae in the lumbar region. The number of the lumbar vertebrae vary more largely than those of any other part of the spine (except of course in the coccygeal region), as the accompanying table taken from Chauveau's *Comparative Anatomy* will show.

Species	Number of Vertebrae				
	Cervical	Dorsal	Lumbar	Sacral	Coccygeal
Man	7	12	5	5	4 to 5
Horse	7	17 to 19	5 to 7	5	12 to 18
Ox	7	13	6	5	16 to 20
Sheep	7	13	6 to 7	4	16 to 24
Goat	7	13	6	4	11 to 12
Pig	7	14	6 to 7	4	21 to 23
Dog	7	13	7	3	16 to 21
Cat	7	13	7	3	21

A study of the above brings out quite clearly that, excepting the tail, the lumbar region is more prone to variation in all domestic animals than any other part of the spine. The horse it is true presents a variation in the dorsal region as well, for there the number has a range of three bones exactly as has the lumbar region, and I think that all anatomists will agree that the variations are generally complementary, that is where we have only five lumbar we find nineteen dorsal or seven and seventeen, respectively. The second anatomical distinction is the presence or absence of callosities upon the posterior limbs.

To those unfamiliar with anatomy I would say that these plates are comprised of epithelial cells arranged in microscopic tubes like those of the horn or the hoof, and are located at the upper extremity of the inner surface of the metatarsal bone. There is also a similar growth of corneous substance growing from the skin of the fetlock. The callosities are always, where present smaller on the posterior limbs, and are supposed by anatomists to be the remains of a prehistoric "thumbnail," in process of elimination by disuse in the course of evolution. As in the first instance I question the wisdom of basing a classification upon a variable character. I now question the wisdom of depending upon the presence or absence of a useless character in process of loss by evolution; for arguing from analogy one would expect to find the callosities eventually gone from all the limbs, if we could see far enough into the future, and during the process one would not expect such a character to be lost in one decade or even one century, but rather that it should first grow smaller and many times appear and disappear before the tendency to reproduce it should be entirely bred out.

The absence of the callosities from the hind legs of certain tribes of horses would in my mind clearly indicate a different environment for many generations and if one chose could make the distinction a difference in race or breed, but hardly a difference in species involving the existence of two parent forms.

The third anatomical distinction is the angle of articulation made by the head and the atlas vertebra, which it is asserted is dominant (in the Mendelian sense) when an animal so formed is bred upon one whose angle of articulation is obtuse. This seems to me a very slight distinction upon which to base a division of species unless it is well supported by other unrelated differences. The fact of its being dominant in cross breeding has no bearing upon the case for it is well known that many, in fact one might almost venture to say most,

abnormal variations are dominant when they occur within a well recognized breed which is much more restricted than the species. Indeed were it otherwise it would be difficult to understand how any variation could be inherited. For when it first appears it must be confined to one lone individual with all the accumulated inheritance of every other individual of the race against it. Should a variation be recessive it is hardly possible to see how it could establish itself unless it gave to its possessor some marked advantage in the struggle for existence. That such would be the case in a horse whose head was at an obtuse angle compared with one whose head set at a right angle to the neck is hardly conceivable for it is well known to all horsemen that no horse has any appreciable difficulty in grazing no matter what the set of its head may be. The long legged short necked foal does find some little trouble for the first few months of its life but not enough to in any way hinder its growth. To take up the other side of the question and decide whether or not the set of the head at right angles to the neck is of any advantage to the so-called forest horse is idle, for he would graze on leaves no matter how his head was articulated. But so far as my observation goes no horse willingly eats the leaves of trees, if grass is available, and I do not believe any breed of horses can exist if confined to woodland where there is no grazing; or that any species of horse in any way connected with those of the present day ever made a living from the leaves of trees or shrubs. All those animals which live on browse have a long pliable upper lip combined with the absence of the upper incisors; an anatomy and dentation so distinct from the genus equus as to warrant not only a difference of species but one of genus as well.

The fourth distinction, that of color is the most unsatisfactory of all. What was the color of the original progenitor of the horse no one has been able to ascertain, but it is generally well known and universally admitted that the variation of color under the influence of domestication, augmented as it has been, by the personal preference of individual owners, is so great as to preclude any intelligent reasoning.

There are dun horses in all countries and in most breeds, and there are red-brown horses with "mealy" noses in all countries and in most breeds, and no distinction of species can at this time be established by the presence or absence of any one color.

To sum up the situation I would say that any theory of a prehistoric horse that is plausible will find some adherents. But no theory should be accepted which is not thoroughly in accord with the facts

recorded in written history. When the historic period commences, speculation ceases, but to meet our own good acceptance, the speculations of antiquaries should dovetail into the facts of written history with complete accord, if any premises fails to do this it should at once be discarded or at least so much of it as fails to meet the requirements. At the very dawn of written history we have this one fact strongly brought out by the kind of negative evidence only possible in such cases. There were no horses known to the early Egyptians. When Abraham and Sarah visited that country about 1900 B.C. the reigning Pharaoh at once appropriated Sarah for his own sole use and benefit and in return made Abraham many valuable presents. In fact the truth seems to be that Abraham sold his wife for a little of most everything the country produced that would be of value to man, but there were no horses in the catalogue.

The first mention we have of horses in Egypt was during the reign of the Shepherd Kings, while Joseph was Prime Minister, and the inscription upon the monuments first contained horses at just about that date—1720 B.C. Egypt was at this time by far the richest and most civilized country bordering upon the Mediterranean Sea and I think it is fair to conclude that what was true of Egypt was true of the rest of Northern Africa. There was no material commerce recorded prior to that of the Phoenician merchants about 1000 B.C. and horses would not be carried to Northern Africa by land without crossing Egypt.

It would seem then that there was no species of horse indigenous to North Africa and the same thing is true of Arabia. Therefore, any classification which includes an Arabian or North African species must in that respect be faulty. My own opinion is that all our horses were descended from one wild species, and that while differences of environment had probably produced some wild established types prior to the dawn of the historical period the greatest variation occurred after domestication, and probably during the last few centuries. We have written evidence to show that there were several recognized breeds as early as the 12th century but I doubt whether the differences were as great as those presented by the various breeds of the present day, either in size, speed, or mode of locomotion.

We have abundant historical evidence to show that the extreme types of our domestic poultry, and many breeds of pigeons, are of very recent origin, and in regard to cattle and sheep we find the same to be true. The Shorthorn and Hereford and Delano Merino and Shropshire have all been developed in what geologically speaking

are recent times, and many of the fancy breeds of dogs are of quite recent origin although they now breed true to type.

In view of these marked peculiarities among the different domestic animals most of which are admittedly derived from one species, it is well to pause and carefully consider the ground before we accept the existence of four species of horse upon evidence established by differences less marked than those presented by the differences in the breeds of other animals.

THE PLANT BREEDING PROBLEM

ROBERT GAUSS
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The problems of dry farming fall easily into two classes. The first, probably the most important, embraces all questions pertaining to tillage and conservation of moisture. The second includes the procurement of plant species so adapted to aridity that they will produce profitable crops without irrigation under climatic conditions like those which prevail over the greater part of what is called the arid region of this country. If it were possible to find valuable plants of this kind growing in other countries, this part of the dry farmer's problem would be simple. All that would be needed would be to introduce or naturalize those plants in the arid parts of the United States. Little adaptation would be required, for, growing under arid conditions elsewhere, plants of this kind would already be acclimatized in nearly every particular to the Far West. But no species of agricultural plants fully acclimatized to aridity have been found. Hence the problem of procuring them resolves itself into the question of acclimatization. I have spoken of introducing foreign plants, if any already adapted to aridity were known. This is called naturalization. Acclimatization is radically different; and it is so much so, that some naturalists have been inclined to doubt if there is any such thing. It involves so great a change in the constitution of a species that it would thrive under climatic conditions radically different from those of its original home. Professor de Vries is one of those naturalists who seem to doubt the efficiency of any attempt at acclimatization, and yet of all writers on this and kindred subjects with whose works I am at all familiar, he has contributed most to the solution of the problem. Darwin says: "I am aware that the attempt to acclimatize either animals or plants has been called a vain chimera. No

doubt the attempt in most cases deserves to be thus called, if made independently of the production of new varieties endowed with a different constitution." In the light of what de Vries has said about the production of new elementary species, I should substitute "species" for "varieties" in the foregoing quotation from Darwin and then say emphatically that an attempt to complete acclimatization from a humid to an arid climate is a vain chimera, if made independently of the production of new elementary species endowed with a different constitution. It is at this point that de Vries comes to the rescue and provides a way of escape from the fate which he seems to think awaits attempts at acclimatization. When Darwin wrote, little was known about distinctions like that which de Vries makes when he speaks of "elementary species." But this distinction must be recognized, for it lies at the foundation of all rational attempts at acclimatization. In the light thus thrown upon it, acclimatization is seen to be the development of a new elementary species, which by reason of its peculiar constitution will thrive under the new climatic conditions.

In an effort to show that there is no such thing as acclimatization, de Vries cites the case of certain annuals which thrive upon the desert during the rainy season. He says that in many respects they present the typical appearance of desert plants, but that when grown under conditions of abundant moisture, they lose their desert character and thereby demonstrate that their supposed acclimatization is not real. Many illustrations of a similar kind are presented by the flora of our arid region. There are numerous little annuals growing on the arid and semi-arid plains which have a range extending to the Atlantic coast. In other words, neither these nor those spoken of by de Vries are true desert species. They grow in desert countries only during the rainy season, at which time the climate is humid and not arid. Growing only during a brief period of abundant moisture, there has been nothing in the history of the species which might, through natural selection, have produced a complete adaptation to the desert climate, instead of merely a seasonal adaptation to a brief period of abundant rain. It is not strange that plants of this kind lose their desert appearance when grown in a humid climate. It would be strange if they did not do so, for they are true mesophytes, never having acquired or possessed a true xerophytic constitution.

An adaptation of this kind may be seen in many varieties of wheat and other cereals which make a more or less profitable growth on the semi-arid plains, but which depend largely upon whether it is a wet

or a dry season. Something more than this is requisite if a species completely adapted or acclimatized to aridity is desired.

This takes us back to the position that what is needed is the production of a new elementary species which will breed true in its drought resisting characters and in everything else.

At this point the problem undergoes another division into two branches. One involves the production of the desired elementary species through cross fertilization and whatever hybrids may be produced in conformity to the Mendelian law. The other has to do entirely with selection, and it is to this particular branch that I have directed nearly all my thought on this subject and practically all my efforts to attain the desired end. It may be questioned whether there is any real breeding of elementary species by this process, for, after all, it is rather a matter of finding the desired exceptional individual, rather than producing it.

I say that it is rather a matter of finding than of producing the desired species, for, again following the lead of de Vries, I am convinced that, if ever found, the looked for individual will be seen to be the result of a mutation in the desired direction, hence practically a new species. In an earlier paper on this subject, I stated that when I began experiments in breeding drought resistant cereals, I thought the desired end might be attained by adding one favorable variation upon another from season to season. But I was not long in discovering that I made little progress. A favorable variation in one year might be completely lost in the year following by a variation in the opposite direction. While working in that way, my efforts were entangled in the meshes of fluctuating variations. Like a pendulum my experiments swung from one side to the other of the narrow range over which fluctuating variations extend. Here again de Vries showed the way of escape. In discussing the evolution of species, he shows that mutations or radical changes in the structure and character of plants may occur in the life history of a species, that the mutations overleap the narrow ranges of fluctuating variations and thereby establish a new elementary species. Entirely free from the entanglements of the old fluctuating variations, this new species continues along its new lines, breeding true and reproducing the new characters as faithfully as the old were reproduced before the mutation took place.

Because of what he has said about fluctuating variations and the development of elementary species through mutuation, I claim that de Vries has shown the possibility of achieving the acclimatization

which in other parts of his writings he seems to try so hard to show is a chimera. That he thinks that in the case of wheat, new elementary species are of frequent occurrence, is shown by his declaration that in his opinion the improvements made by Hays in the wheats of Minnesota were due to the development of new species of an elementary kind. I also think they are of frequent occurrence.

To avail oneself of mutations in the development of drought resistant species, one must look for mutations in the direction of drought resistance. This is why I said it is a matter of finding rather than producing the desired species. It is evident that the greater the number of plants subjected to examination, the greater the probability that the desired mutation will be found. Under this theory, every field of wheat grown on a dry farm becomes an object worthy of careful examination. For the encouragement of persons engaged in this search, it is well to recall the fact that Sheriff, the famous English discoverer of new and valuable species of wheat, achieved his great results by examining the wheat fields of the neighborhood in which he lived.

All experimental breeding with reference to the acquisition of drought resistant species by selection should be conducted upon as extensive a scale as possible. Little can be hoped from the cultivation of small plats or beds of wheat containing a few hundred or even a few thousand individual plants. The plants should be grown far enough apart to admit of the careful examination of each one separately. But they should be grown not by the thousands but by the hundreds of thousands. The work should be carried on at every experiment station in the arid region, whether under state or under federal control. Out of the need of widely extended work of this kind has grown the project for the establishment of a botanical laboratory at some central point which would be in easy communication with all parts of the arid region—embracing not Colorado alone, but all the arid states. Plants showing what might seem to be mutations of the desired kind might be sent to this laboratory for examination, and the seed from specimens shown to be valuable could be saved for replanting.

A bill prepared by me and introduced in congress last winter by Senator Guggenheim and Representative Taylor provided for a laboratory of this kind to be established in Denver, that city being more favorably situated than any other for close communication with all parts of the arid region. That bill contemplated extensive experiments of the kind I have outlined and designed to secure the adap-

tation of valuable species to aridity. It also contained a provision for similar experiments to be conducted on the high mountains of Colorado with a view to adaptation to low temperature. For this feature of the project I am indebted to Mr. Levi Chubbuck of the U. S. Department of Agriculture, who last winter made his home in Denver. He was especially interested in the development of Alaska agriculture, and he hoped that by experiments upon the high mountains of Colorado, valuable species might be developed which would be adapted to the climate of that far northern part of the national domain. Experiments of this kind like those designed to secure adaptation to aridity, would suggest the wisdom of establishing the proposed laboratory at some central point like Denver.

I am also indebted to Professor Ellsworth Bethell, the well known Denver botanist, for the suggestion which was subsequently embodied in a provision for investigations to be made in connection with the proposed laboratory into the plant diseases more or less common in this part of the arid region.

A well equipped botanical laboratory is an essential part of any extensive scheme of experiments designed to promote the acclimatization of valuable species, to aridity, and also to low temperature. But as it has not been my design to discuss at length this particular feature of the scheme, I think that what I have just said on that part of the subject will suffice. To restate the main points of my theory of plant breeding with reference to aridity, it is in my opinion essential to bear in mind that the problem is one of acclimatization; that its solution is to be found in the discovery or development of new elementary species possessing drought resisting character; that those elementary species are to be developed through favorable mutations, that in order to increase the probability of the occurrence of mutations of this kind the breeding experiments should be carried on upon as extensive a scale and at as many different places in the arid region as possible; that every dry farm field should be searched for plants possessing the desired character; and that by the maintenance of a botanical laboratory at some central point, means would be provided for the examination and study of promising plants which might be found growing on dry farms or at an experiment station in any part of the arid region.

Finally, I have this to say to all dry-farmers: Plough deep, stir the surface of the soil, conserve the moisture, use none but acclimatized seed, and time will prove that this early settlement of dry-farmers is but "the first low wash of waves where yet shall roll a human sea."

DOMESTICATION AND ACCLIMATIZATION OF WILD MAMMALS

D. E. Lantz

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The steps by which man rose from the savage state and attained his present degree of enlightenment are marked by the progress he made in domesticating animals and plants and subjugating them to human uses. Could we fully know the history of our domestic animals it would enable us to understand the processes by which the races of men came to the mastery of things about them. Primitive man must have especially lacked forethought for future seasons, and it is possible that he first acquired it through the necessity of making provision for the animals which he possessed.

After primitive man had taken a few steps in domesticating wild animals and when he saw that the results had contributed to his comfort and happiness, he had a strong incentive to further achievements in taming other animals and plants. The process of domestication went forward slowly until he had tamed all the animals and plants we now have in possession. Man has been uplifted by the process as well as by the results. His association with lower forms of life in domestication has enlarged his sympathies for all life and has the better fitted him for intercourse with his fellows.

And yet comparatively few of the higher and more useful forms of animal life, mammals and birds, have been domesticated. Of about 5,000 species of mammals now inhabiting the world, only about 25 may be said to be really serving man as beasts of burden or furnishing him with food, clothing, or companionship while in a state of dependence upon him. Of birds, the proportion of domesticated species is even smaller. No important increase in the list of animals under domestication has been made in the last five hundred years. In the plant world, on the contrary, the last few centuries have witnessed a wonderful development of new forms under domestication.

The preceding statement is not meant to imply that our domestic animals have been neglected. Most of them have been plastic in the hands of breeders, their value has been greatly increased and will be still further enhanced as the years pass. Nor have agriculture and commerce alone benefited from the study of our domestic animals. Science has been equally enriched. The influence upon the doctrine of evolution and theories of heredity and sociology can not be overestimated. Comparative anatomy, embryology, physiology, hygiene,

and preventive medicine have all been enriched by the study, and practical surgery owes its progress in large measure to the knowledge gained from investigations made with domestic animals. The mammals have afforded the best field for this research.

Several practical objects are to be attained by further efforts to domesticate wild mammals. Who will say that more beasts of burden would not benefit the world? The zebra and the African elephant may well repay their subjugation in their native land. Then there is the matter of conserving and increasing our supply of furs. The most rational expedient seems to be the breeding of fur bearers in domestication or partial domestication. This, too, presents the only means of preventing the loss of species through extermination. The extinction of the quagga and the blaubok from the South African fauna could easily have been prevented had forethought been applied to their preservation.

The charge has been made that the desire merely to preserve a species is sentimental and has no practical value. I maintain that in this matter both sentiment and economy are worthy of consideration. A large number of the species that have come under human control were first tamed solely for the pleasure they could afford their possessors. This is true especially of flowering and other ornamental plants and of some animals, as, for instance, the canary. In a measure, this is always considered in the selection of species and individuals for breeding, and it must have a marked influence in deciding the fitness of wild species of mammals for domestication.

From the economic standpoint, the strongest argument for attempting to breed wild mammals in captivity is the production of food for the human race. The American pioneer found a great variety of game in our forests. But this source of food has diminished until few can avail themselves of it, and we are coming to a time when the production of game in preserves is the only way to have it. Yet our aim should be not so much to furnish more game for sportsmen as to provide a greater variety of food for the people.

Two sources of additions to our present list of domestic animals are possible. The first, and the more desirable, is to select from our native species of fur or game animals. These require no preliminary experiments in acclimatization. The other plan is to bring in exotic species. The selection of a foreign species for introduction and experiment must depend on a similarity between its natural and the proposed habitat or on its probable adaptability to the new surroundings. This adaptation may sometimes be judged from the history of former

attempts to acclimatize it or its near relatives. For this purpose the experience of zoölogical parks becomes helpful. But in a country so large and so varied in climate as ours the same general principles must be considered before transferring a native species from one locality to another.

Of our native mammals, two kinds of deer have proved themselves adapted to every part of the United States and have done well in confinement under nearly all circumstances. These are the wapiti, which we miscall the elk, and the common white-tailed, or Virginia, deer. Both promise to become important sources of food and of great economic value. The other species of American deer seem to be less adapted to life outside their natural range. The same is true of the pronghorn, or American antelope. While the bison is apparently perfectly hardy in all parts of the country, it is doubtful if it could be made of sufficient utility, even if bred in large numbers, to take the place of the cattle which it would displace on some of the ranges. Its extreme hardiness is the chief factor in its favor. Yet in spite of the high value of buffalo robes, cattle raised on the same area would probably pay better than the bison. On the other hand, deer can be raised on areas unsuited to cattle and utilize much land now unproductive.

Of our native fur animals, several species are worthy of patient experiments in breeding them in confinement. The beaver, the otter, the black and silver foxes, the marten, the mink, and even the skunk and the muskrat present possibilities for the breeder who is also a patient investigator. Thus far success has crowned very few of the efforts to produce furs in captivity. It remained for a Belgian, one Johan Beetz, living in remote Labrador, to show that the common red fox when bred with black stock produces a preponderance of black and silver offspring. In five generations the red stock had given way to black; and, in a letter to the Department of Agriculture, Beetz claims that he has now purebred black foxes without apparent tendency of reversion to the red type. This would seem to show that the black is probably the ancestral form of our red foxes.

While our native species should have first consideration as subjects for experiments in domestication, many exotic species might be profitably acclimatized either as wild game or to be bred in captivity by our people. The list of species available is too great for more than general mention.

The Old World antelopes, members of the family Bovidæ, include many valuable food animals. In Africa there are more than a hundred species, many of them hardy and most of them excellent game.

Fully a score of species would be promising subjects for acclimatizing in America. Africa, like our own country, has arid sections, and some of her antelopes are probably especially adapted to the desert lands of our Southwest, and might be used to restock parts of that region from which our own pronghorn has been exterminated.

The eland (*Taurotragus*), the largest of the antelope family, is threatened with extermination over the greater part of its range in South Africa. Its average weight is from 800 to 1,100 pounds, and old males have been known to attain a weight of 1,400 to 1,500 pounds. This animal has often been recommended for rearing in captivity because of the excellence of its flesh, which is said to be superior to beef. Harris, the African traveler, states that while it resembles beef in grain and color, it is far better flavored and more delicate, possesses a pure game flavor, and is remarkable for the quantity of fat interlarded between the muscles.

The eland was introduced into Holland by the Prince of Orange in 1783. It was acclimatized in England by the Earl of Derby in 1842, and was bred successfully in his parks. After his death the herd passed into possession of the London Zoölogical Society in 1851, and continued to increase in numbers for many years. In 1899 the Duke of Bedford had a fine herd of 14 elands in the park at Woburn Abbey.

The scarcity of this game animal in a wild state and the consequent cost of obtaining stock would probably make experiments in breeding it in the United States prohibitive to individual enterprise. However, the experience with the animal in Europe gives assurance that efforts to acclimatize it in the United States would be successful.

The eland is only one example from a long line of exotic antelopes that might prove valuable in the United States. The deer family represents another equally important class, from which, besides the already partly domesticated fallow deer, there might be taken the sambar, the axis deer, the swamp deer, the Chinese water deer, the muntjacs, and other promising representatives. In suggesting the acclimatizing of these animals in the United States, we do not advocate their indiscriminate introduction nor the immediate release of any of them to resume their wild life. The history of the introduction of beneficial animals into new localities should teach caution in such experiments. Even species fully domesticated have become injurious when neglected and allowed to run wild. Devastations of crops by horses, cattle, pigs, and goats, introduced into new countries for domestic use and afterwards abandoned, have been known in many parts of the world. The destruction of native birds and mammals

by dogs and cats that have gone wild furnishes an equally valid argument for caution. Probably less danger attends the acclimatization and release of the class of animals under discussion than any other; and yet it is known that deer and antelope under certain circumstances have increased so enormously as to destroy important crops. Ordinarily should they prove injurious in the United States, the removal of protection would be followed by their speedy extermination as game.

The history of former attempts to acclimatize exotic animals in the United States is interesting. Fallow deer and red deer were successfully kept in some of the early deer parks of Maryland and Virginia. Washington kept both fallow deer and native Virginia deer on his Mt. Vernon estate. In recent years red deer have been introduced into some of our larger game preserves in America, but apparently have not thrived as well as our native species. A few years ago an organization of California sportsmen proposed to introduce gazelles in our Southwest, but thus far no importations have been made. The great camel experiment made by the War Department before the Rebellion has been regarded as a failure; but as an experiment in acclimatizing the animals it was really a great success, for they proved to be well adapted to our southwestern conditions. That they should prove unprofitable as army transports was an entirely different matter.

The alpaca experiments of sixty or seventy years ago were unsuccessful because attended by lack of judgment as to the localities suitable for the animals. For many years agitation was rife for a trial of the alpaca as a wool producer in northern latitudes. As early as 1840 alpaca societies existed in both England and the United States. A memoir on the alpaca written by a Mr. Walton was published in London and had wide circulation. Several wealthy men in England and Scotland imported the animals for breeding. Queen Victoria and Prince Albert in 1845 appeared in court robes made of alpaca wool grown in the park at Windsor. The largest shipment of the animals for the United States came from Aspinwall in 1859 on the brig *E. Drummond*. The total shipment was 71 animals, but 29 died during a severe storm and only 42 were landed in New York. Some were taken to places in New York state and New England, but it was soon found that the animals were equally unsuited to the humid climates of Great Britain and the Northeastern United States. Had they been introduced into the arid western country, they would probably have thrived as well as they do on the Pacific Slope of South America, their natural home.

The time for beginning experiments in the introduction of foreign food animals and for scientific attempts to breed our native game and fur animals in captivity has surely arrived. To delay them much longer is to permanently lose the opportunity for some. The well-located game reservations now existing, the government experiment stations, and the national parks afford the best of surroundings for the experiments. The men for conducting them can be obtained. The expenditures for stock, transportation, fences, buildings, and maintenance need not be a great drain upon either private or public resources. Only moderate appropriations would be required; but permanency of the establishment would be a necessary condition, for the problems are not of a kind that can be solved in a few years. A wild species cannot be domesticated during the life of a single generation of man. Yet the economic benefits from such experiments as I have suggested need not wait for the full domestication of a single species. Some of the advantages can be reaped within a decade after the experiments are inaugurated.

REPORT OF COMMITTEE ON HEREDITY OF FEEBLE-MINDEDNESS[a]

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During the past sixty years the care and training of feeble-minded children has grown from a small beginning, in a private residence in a New England town, to a point where approximately 19,000 of this class are cared for in about fifty public and private institutions in the United States. It has been a period devoted to extension and the development of a policy with regard to the class. Research concerning its etiology has necessarily received but secondary consideration. Its desirability has been recognized throughout, but financial support for it has not been forthcoming. In token of the recognized desirability of research, the institutions for the feeble-minded in this country have been, during this entire period, gathering such data as the parents, friends, and relatives of the beneficiaries of the institution would voluntaily furnish, either at the time of the admission of the latter or during interviews, as occasion afforded opportunity at various times afterward. These data have never been considered of very great value and have been used only to illustrate the large

[a] Read at the Columbus meeting of the Association, February 1, 1911.

percentage of defective, neurotic, or diseased ancestors of feeble-minded persons. For instance, the report of Dr. I. N. Kerlin on "Etiology of Idiocy" in 1880,[b] "The Ascribed Causation of Idiocy," etc., by the writer in 1884;[c] "The Causation of Idiocy and Feeble-Mindedness," by W. F. Wilson, M.D., 1894;[d] Statistics of Heredity," by Dr. J. C. Carson in 1905;[e] and "The American Table," by Martin W. Barr, 1904.[f]

The increasing comprehension of the magnitude of the feeble-minded problem gives rise to a demand for more accurate information as to its etiology. We are passing into a period when students of this subject can no longer be satisfied with the prefunctory reports of relatives, as exhibited in institution records.

The work promoted by Mr. Johnstone and Dr. Goddard at Vineland in this particular field and by others in this Association, in other fields, illustrates the perfect feasibility of the new method. Vineland, N. J., Lincoln, Ill., Faribault, Minn., and Glenwood, Iowa, have established their departments of research. In each institution, as at Vineland, the work will be divided between two interests: (1) Laboratory research, including psychological examination of children, and (2) field work, having for its object the discovery of hereditary conditions of an etiological nature. In the three institutions last mentioned, respectively, Dr. Huey, Dr. Kuhlmann, and Dr. Lange are devoting their time entirely to laboratory work, though the State Board of Control in Minnesota has asked for a special appropriation, which can be used for field work also. If this appropriation is granted, it will be for the use of all the Minnesota state institutions interested in the subject of etiological investigation. It is proposed to enlarge the present agency, which is now, under the law, devoting its time entirely to examining social conditions of patients and inmates who have gone out from hospitals for insane and the School for Feeble-Minded and Colony for Epileptics. The extension of this work to include the study of hereditary conditions will enable us to make a necessary and important beginning in this latter line.

The secretary of this committee, Dr. Goddard, who has been the pioneer in research work assigned to the committee, has given splendid illustration of the results of the field work. From the table

[b] Proceedings, Association of Medical Officers of American Institutions for Idiotic and Feeble-Minded Persons, 1880, p. 150.

[c] Ibid., 1884.

[d] Minnesota State Conference of Charities and Corrections, 1894.

[e] Fifty-fifth Annual Report, Syracuse State Institution for Feeble-Minded Children, 1905, vol. 1, p. 34.

[f] Mental Defectives, p. 94.

Summary of heredity lines of 187 families whose members are connected with inmates of Vineland Institution for Feeble-Minded January 27, 1911.

Series number.	Average mental age.	Total number families.	Condition {Heredity or mating.	Immediate Family. Feeble-minded.	Immediate Family. Normal.	Immediate Family. Unknown.	Immediate Family. Died in infancy, dead and miscarriages.	Immediate Family. Total conceptions.	Whole Family. Feeble-minded.	Whole Family. Normal.	Whole Family. Died in infancy and miscellaneous.	Whole Family. Alcoholic.	Whole Family. Criminal.	Whole Family. Epileptic.	Whole Family. Insane.	Whole Family. Sexual pervert.	Whole Family. Tubercular.	Whole Family. Generations.	Total number tabulated.
1	7	12	F. × F.	44	0	13	14	71	124	109	93	8	3	1	7	12	9	4	322
2	7	9	F. × F. (plus)	28	0	5	10	43	130	57	63	12	4	2	1	17	14	3	321
3	5	2	F. × F. (ep.)	3	0	9	1	13	52	12	11	3	1	4	2	12	0	4	116
4	7	5	Ep. (plus)	13	3	14	8	38	60	22	50	5	1	7	1	6	8	4	202
5	5	13	F. male (plus)	19	14	17	23	73	62	165	142	13	1	2	2	7	25	3	591
6	6	33	F. female (plus)	72	17	29	66	184	250	190	433	64	10	3	6	31	66	4	1,289
7	5	47	F. M. heredity	75	47	34	106	262	161	577	569	44	0	12	19	13	61	4	1,978
8	4	6	Mongolian	6	21	0	6	33	10	131	145	1	0	1	1	0	2	3	205
9	5	60	Nor. heredity	60	165	46	82	353	60	962	578	43	1	5	15	24	49	3	1,983
10	3	21	Nor. heredity and N. × N.	21	88	8	31	148	21	490	228	5	0	1	4	11	11	4	823
11	..	21	F. × F. (matings)	66	0	10	12	88											
Summary of Series 6		121	Feeble-minded heredity	254	81	116	228	680	839	1,132	1,369	149	20	31	38	98	183	4	5,019
Summary of Series 5		60	Normal heredity	60	165	37	82	353	60	962	578	43	1	5	15	24	49	3	1,983
Summary of Series 1, 2, 3, 11[a]		44	Feeble × feeble	141	0	37	37	211											

Note—F. × F. = both parents feeble-minded, with no other defects.
F. × F. (plus) = both feeble-minded and one or both alcoholic or tuberculous or the like.
F. × F. (ep.) = both parents feeble-minded but with epilepsy.
F. male (plus) = father feeble-minded and mother normal mentally but one or both alcoholic, etc.
F. M. heredity = neither parent feeble-minded but feeble-mindedness found in the ancestry.
Nor. heredity = no feeble-mindedness to be found in family—(parents may be alcoholic, etc.).
Nor. heredity and N. × N. = parents free from alcohol, etc.
F. × F. matings = includes all cases where husband and wife are feeble-minded besides the parents of the child in the institution.
[a] The total of these three lines does not equal that of the column above, owing to the exclusion of duplicates.

which is presented here, it will be noticed that the Vineland force have reported on over 5,000 people as to their positions in hereditary lines connected with inmates of the Vineland institution, involving the study of 225 families.

It is unnecessary to dwell upon the details of these reports, which are presented elsewhere, except to note that, so far as the investigation has gone, there has been no instance discovered of a normal child resulting from the mating of defective parents.

The committee feels that the way is opening for large, interesting, and important results.

A COTTON VARIATION WITH A SELF-FERTILIZED ANCESTRY

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In the spring of 1906 the writer began a project in connection with the cotton-breeding work of the Bureau of Plant Industry, U. S. Department of Agriculture, to determine by accurate experiment the effect of northward or southward change of seed on the season of maturity of Upland cottons. For the starting point three varieties were chosen, viz., the Ramsey, a Louisiana variety; the Triumph, a well-known variety of Texas origin, and the Tennessee Greenseed.

It is somewhat fortunate that of the three most pronounced variations from progeny rows in the field, after some six years' experience in breeding Upland cottons, one should have occurred in a pedigree culture.

The Tennessee Greenseed is an old variety which a generation ago was apparently almost universally cultivated in Tennessee, and perhaps within the northern limits of Alabama and Mississippi. The stock used in these experiments came from the plantation of the late James Walker, of Lauderdale County, Tennessee, and grew within three or four miles of the Mississippi River. Mr. Walker had never during a period of thirty years permitted any other variety to be raised on his farm, and had used his own gin exclusively for his own crops.

A typical plant of this variety was chosen in 1905, and the seed was planted in a row on the farm of the Tennessee Experiment Station at Knoxville in the following year. It may be stated in this connection that, owing to the several climatic factors involved, the season

suitable for cotton growing is at Knoxville considerably shorter than at the Mississippi River, more than 400 miles west. From an experience of six years with the crop in both sections the writer has learned that there is a difference of fully three weeks in the time of safe planting of cotton seed between the two localities.

As stated, seed from the plant above referred to was planted in the spring of 1906. That year and each succeeding year flower buds were covered with paper bags and securely tied on the day before the blossoms opened. These bags were allowed to remain attached to the bolls for several days. Under favorable conditions a very large percentage of blossoms treated in this way have set perfect fruit. After four generations of self-fertilization there is no apparent deterioration of vigor in the offspring.

The only object of this experiment was to determine the effect of latitude and concomitant climatic factors on maturity. An effort was made to avoid any definite selection, though on the few days chosen for covering buds in midsummer naturally the plants having the larger number of flowers at the time were the ones most likely to be perpetuated.

No marked difference was observed in any of the progeny rows until 1910. Unfortunately, the difference that then came to light did not attract attention until after October 28, when all the plants were killed by frost.

On a subsequent visit to the plots, the astonishing contrast between three of the progeny rows and all the others was visible. Every plant in these three rows was stout, strict in habit, and at least a third taller than its cousins in the other rows. Moreover, the crop was quite late in maturing. This was shown by the fact that the short season had not permitted half as many bolls to reach maturity and open as in the other progeny rows. Both these points come out clearly in figure 1, which shows adjacent progeny rows, the left-hand row representing the variation. In fact, a casual inspection of the plots after the plants were killed by frost would indicate a greater difference between these two progeny rows, the self-fertilized descendants of one ancestor four generations back, than existed between any two of the original varieties with which the experiment began.

The relationship of these three tall progeny rows is shown in figure 2. The progeny rows marked E, F, and G, the ones under discussion, are shown to have come from three plants out of a single progeny row in 1909. This row must have shown some such indication in 1909,

but it was not observed or recorded, perhaps because of unfavorable conditions for the difference of habits of growth to become manifest.

In figure 2 is exhibited one seed from each plant grown in the culture of 1910 (except two overlooked by mistake). These seeds were taken at random, one from each plant, and are shown in a vertical row above each lettered circle indicating the twenty-three progeny rows of 1910, from A to X, inclusive. The seed in progeny rows E, F, and G, are seen to be distinctly larger than the average of those from the other rows, and exhibit a distinct tendency toward smoothness or absence of tuft. On inspection of progeny rows B, C, D, it was observed that the plants almost uniformly matured somewhat later than in the progeny rows A and H to X, inclusive. They also showed a slight inclination toward the slender habit of E, F, and G. For the origin of this mutation we are, therefore, to look back to the exclusive common ancestor of all six of these progeny rows chosen from the crop of 1907, as clearly indicated in the genealogical lines proceeding from that circle in the diagram shown.

FIG. 1

It appeared to the writer as quite interesting that such a distinct variation should appear in a self-fertilized line. While the temptation

is strong to generalize on the results of such a phenomenon, especially in view of two other somewhat similar results obtained under field conditions with other varieties of cotton, the purpose at present

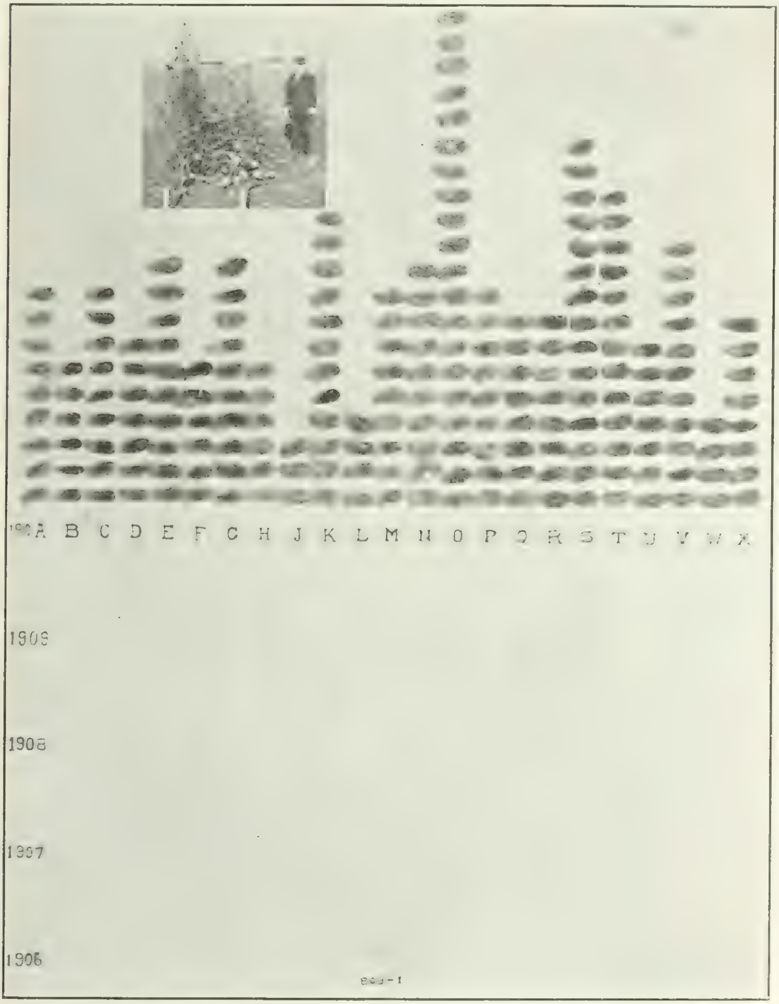

FIG. 2

is merely to record the experiment. Very similar variations from Triumph cotton are discussed by Mr. O. F. Cook, in "Local Adjustment of Cotton Varieties," Bulletin 159, Bureau of Plant Industry, U. S. Department of Agriculture, pages 20–25. These were the result

of transfer of seed from one locality to another, with a considerably smaller contrast of climatic conditions than the case cited in this paper. Much larger numbers of plants were used in the Texas experiments, but the seed had not been produced under conditions of self-fertilization.

HEREDITY ONE OF THE LARGE CONTROLLABLE FORCES[a]

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Science has at last undertaken to organize the business of plant and animal breeding as it has organized mechanics. The world has come to see that the force of heredity gives rise to economic values just as truly as the force of electricity. The laws of heredity are beginning to be formulated by scientists as other investigators are building up the sciences which underlie mechanics. Breeders are devising methods for creating new values from the many domesticated species of plants and animals as other men are inventing machines. Breeders are creating larger values, in the form of larger yielding strains of corn, wheat and vegetables, again in the form of larger meat and butter production, or yet again in form of speed, beauty or strength in horses and combinations of form, color and fragrance in flowers.

None will be more surprised at the advances arising from the study of heredity than those who make a study of the purely physical sciences in relation to mechanics. The word *breeding* is no longer sufficiently comprehensive to designate the science of heredity and its practical application to the improvement of living forms. The broader word *genetics* has come into use, to signify man's activities in approaching the truth about this abstract force called heredity and also in utilizing the new knowledge in efforts to improve the types of plants, animals, and men.

The term "breeding," which was long used in connection with the improvement of domestic animals, is now applied quite as much to plants. The fact is that in the past decade plant breeding has overtaken animal breeding both in technique and in achievement of remarkable results, thus illustrating the rapidity with which genetic subjects are being taken in hand. And now that science has entered

[a]Condensed from an address before the American Breeders Association, Feb. 1, 1911.

the field of human descent, a third division of genetics has gained recognition under the name eugenics. Five years ago the first Committee on Eugenics was formed by the American Breeders Association; recently, by an almost unanimous vote, the Association changed this Committee to a Section of Eugenics, coördinate with the Plant Section and the Animal Section.

A whole category of new words is being provided to express the newly discovered facts and phenomena of heredity and the newly devised methods of breeding. A new literature is rising as a result of the discovery and elaboration of Mendel's laws, nearly as voluminous as the literature which grew out of the labors of Charles Darwin, and of even more definite character. Mendel and his followers promise to have as profound an effect in developing the science and methods of evolution by systematic effort as Darwin and his followers had in bringing the world to believe in natural evolution. Darwin's followers were over-zealous in ten thousand times proving the correctness of his general theory. Mendel's followers show earlier signs of being satisfied with over-sufficient proof, and they are entering mightily into the effort to make his discoveries of large and immediate use to the world. With Mendel's methods of analysis and synthesis they are studying even the intricacies of human descent. They are showing that those unit characters which represent the worst of human dross may be discarded and that the better elements of human nature may be recombined in races of people averaging stronger physically, brighter intellectually, cleaner morally and withal more efficient as members of society. No one can as yet speculate as to the effect the science of genetics may have in helping humanity to evolve into races with superior heredity.

Heredity may be crudely likened to a fabric woven of many kinds of fibers and with many colors. Under this general conception of the nature of the "network of descent," suggested by Dr. O. F. Cook, the following observations may be made: That there are units in heredity or unit characters which may be likened to the units or individual strands of the woven fabric. That some of those units may be likened to different classes of fibers used in making the threads; others in the heredity of a species may be likened to the different fibers or threads of the fabric; others to the form of the fibers, and yet others to the strength of the fibers. That some unit characters may be likened to the entire fabric produced by the loom; some to the form patterns laid on the surface of the fabric by the loom; and some to the color patterns worked out by bringing to the surface of the fabric

threads of specific colors. Thus in living things there are woven into a systematic network general characters, as of form, color or habit; also characters of secondary importance, as of minutiæ of form, detail of color; and even characters so small as ordinarily not to be discernible. There are characters of prime importance in the makeup of plants and animals which broadly compare with the general appearance of the fabric, secondary characters which compare with the figures of form or color which may be woven into the fabric, and even characters relatively more minute than the almost microscopic fibers of which the threads of the cloth are made up. In reality, however, even the intricate organization of the product of the most complex modern loom but very crudely illustrates the delicate intricacies of heredity in the network of descent in living things.

The simile will also serve in another direction because there are agencies in the generative cell which determine how these unit characters shall be woven into the network of descent; as in the modern loom the perforations in the loom-ribbon determine which keys shall release the shuttles bearing the threads into their proper place in the fabric; or as in the street organ the perforations in the music-ribbon determine which keys shall strike the notes in making the harmony of the music.

The really stable part in the heredity of plant, animal or man is not the individual body—this runs its course and dies—but rather the germ plasm, which holds within its substance the well-nigh immortal threads of descent. These compete for place as they run through successive generations and are woven together in somewhat unique fashion in each individual. The discovery by Mendel and others that unit characters are inherited in pairs and appear in numerical proportions in the progeny was a great biological surprise. But the significant genetic facts are: that units of character are the stable parts of heredity; that, like the threads and colors of the cloth made in the loom, they may be so manipulated as to leave out of the combination those characters which are less desirable; and that the choicest characters may be recombined in individuals of higher excellence and higher average of efficiency. In some cases this elimination and recombination can be accomplished formally, while in other cases it can be accomplished only informally as by the aid of large numbers of hybrids.

In the light of the wide general experience of the breeders of plants and animals, efforts at mathematical recombination, while very important, represent only a small part of the intricate and truly large prob-

lem of gradually building up improved networks of descent to meet all the agricultural conditions in which plants and animals are used. As a matter of fact, breeders are coming to recognize the fact that this new philosophy of breeding will serve as a guide in the details of breeding work. The most of the work of animal and plant improvement will continue to be selection, including the discovery of the occasional mutation and the immediate or gradual segregation of this blood into a new variety or breed. Thus, even with this new science of heredity, breeding will still be mainly an art, and scientific methods will be used to supplement it. Thus, with many plants and animals, statistical records of performance may be widely used in determining the relative economic values of the different strains and families. In the breeding of many species there is relatively little opportunity for statistical methods, and a very wide range for the use of the judgment of the trained artist in discovering mutating qualities and in making desired combinations by crosssing and hybridizing. In some species the large results secured have come from mere art, and the use of very large numbers to find the occasional mutation and in the segregation and selective development of the mutating plant or animal.

Substantial advances are being made in cytology, which is the study of the internal anatomy and functions of the generative cell. Some of these questions are necessarily very abstruse and hard to investigate. Among them are these: How do the characters of the parents pass through the generative cell into the progeny? How does one character, as color in cattle, remain dormant in one or more generations, and then the progeny of a later generation reappear in apparently unmixed purity? It is clear that since the living organism carries the power of reproduction from one generation to another, carriers for the general, secondary, and minute character are multiplied every generation, so that each is represented in the generative cells of each individual among the progeny. Thus the new generative cell contains all the character determiners which control the complex makeup of the mature individual.

The new conception given by Mendel has helped to clear up the question of the influence which environment exerts on heredity in case of unit characters which have remained intact through thousands of generations of individuals and now powerfully maintain their unit purity in the presence of the opposing members with which their heredity carriers pair in the plasm or substance of the generative cell. The manner of origin of these unit characters, as horns in cat-

tle, color of eyes in man, stiffness of straw in wheat, and their heredity carriers seems to be the next great work for genetics students to attack. The breeding of animals has been left largely to private enterprise. While numerous new varieties of plants have been originated under public auspices, very little has been done in originating new breeds of animals at public expense. True, there has been some public assistance to associations in testing the cows of members so as to weed out the unprofitable ones, and in organizing associations for the ownership of superior sires, and some aid has been given to the dairy breed associations in their praiseworthy work with advanced registration based on records of actual performance. France and other countries have subsidized especially good sires so that they would be kept in certain districts, thus improving the live stock of those districts. Russia and other countries have done something at producing on government breeding farms, breeds or sub-breeds of horses for army mounts. The Department of Agriculture in coöperation with the Colorado Experiment Station has begun an experiment to produce heavy harness horses. It is also coöperating with the Vermont Experiment Station in improving the Morgan breed of horses. Together with the Minnesota Experiment Station it has assisted a coöperative association of breeders in establishing a circuit for the creation of a sub-breed of Shorthorn cattle known as milking Shorthorns. It has a similar relation with the North Dakota Experiment Station in aiding an association of breeders to establish a coöperative circuit breeding association in creating a sub-breed of Holstein-Friesian cattle.

The literature in reports, books, genetics magazines, and other publications already indicates that genetics is to be very fruitful in technique and in practical facts relating to the direction of the forces of heredity so as to make not only our plant and animal production larger but also to give us a cleaner and more efficient network of human descent. Our agricultural colleges and agricultural high schools, and other schools which give instruction to farmers, are beginning to take hold of this subject in its new form and to create new courses of study which are scientific, practical, and valuable from a cultural point of view as well as important from the standpoint of practical plant and animal improvement. Our educators and even our moral and religious teachers and leaders are beginning to study the newer phases of the subject of heredity in relation to their work. The first decade of the twentieth century will serve to mark the time when science laid hold of the subjects of heredity and breeding

in their larger constructive relationships in developing moral and general worth in men, and there is no phase of this subject which is now coming forward in a more significant way than the science of eugenics, or the improvement of the network of descent in the human family.

When the movement for world peace shall have centered all national power in one great federation, the patriotic instinct will become altruistic in a far broader way than now. The absence of strife with the outside enemy will leave the impulse of patriotism free to develop along lines of efficient service to the whole human family.

More than ever men will have patriotic pride in adding a new scientific fact, a new invention, a new piece of literature, a new variety of plant or animal, a new law or a new method of so organizing society as to make for the betterment of particular communities or of the whole race of men. The production of good citizens and the improvement of the heredity of the race, as well as the securing for all people superior environment, including education, will become a racial movement. Eugenics will become one of the practical sciences.

Patriotic people will not only desire to know the general values of races, families and individuals, but they will desire also specific knowledge of the presence, value and persistence of the unit characters of which their heredity is made up. It would seem that in no other function is our patriotism so unguided as in evolving lineages of human descent.

In our boasted patriotism in times of war, we have been blind to the fact that wars destroy a large percentage of our best men, giving a larger place in the continuance of the nation to the heredity of second-best men. Dr. Jordan's work in this Association has shown that this alone should be a most potent reason for the cessation of wars. Wars, instead of being necessary to keep up the virility of the race, weaken it.

It is not too optimistic to believe that under the direction of economic, political, social, and eugenic science we are to strengthen the blood currents of the nation, as well as greatly improve the environment of the individual. War as a means of world uplift has been overestimated. The value of science and altruism are never overestimated in making a better race of men.

That the scientific study of this subject is a patriotic racial duty can not longer be denied. To recombine and perpetuate those units of character which compose strong individuals, families and races and multiply them so that they may form a larger percentage of the whole

human family will come to be true personal patriotism. On the other hand, to produce people below the average in efficiency, and especially to combine unit characters which increase the defective and criminal individuals and families, will come to be considered definitely unpatriotic.

Patriotism, in its broadest and even in its religious sense, must be appealed to, that those families with the most efficient heredity may multiply rapidly and become a larger and larger percentage of the whole human family in each generation. In the absence of an awakening of this patriotic eugenic sense the efficient and well-to-do now, in too many cases, instead of having families large enough to rapidly increase their types, are having so few children that they become relatively smaller and llerams portions of the population with each generation. On the other hand, some weak, defective and criminal families are annually becoming larger and larger parts of the entire national heredity. And society, having protected them, through sanitation and charity, has helped this last-named class to become a relatively larger part of our population than when the law of the survival of the fittest had a freer scope to work out its harsh decrees.

It must be recognized that the great middle producing classes—our farmers, mechanics, and other manual workers—are our balance wheel in genetics as in economics and in politics, and our strength in times of war. Among them there is wide genetic variation as to individual family and racial efficiency. Eugenic patriotism to be effective must be generally operative among these substantial classes which produce the bulk of the efficient young to do the work of each generation, because from among this great class come most of our leaders.

The fact that science has started to organize eugenics is at present the striking new thing; and who knows what the future may develop? Whatever the result, it will not be visionary, and the movement, while conservative, may not be so slow as have many other movements for human betterment.

The aim of eugenics will not be different from that of education, physical, intellectual, and moral. It will be only another and more certain method of producing men and women of ideal character. The ideal remains the same, but the unvarying natural laws will be brought to bear in bringing about the desired result. Eugenics will help in producing a race which will more readily respond to general education and moral teaching; on which no money need be wasted in combating evil tendencies and weaknesses.

The deductive scientific method having found a foothold in relation to heredity in all living things, living protoplasm has more than ever come under the dominion of man's will. He proposes to weave new networks of descent in the form of plants which shall store up the energy of the sun more abundantly than any plants heretofore; other new networks of heredity which shall transform plant substance into more meat, milk, work and other forms of superior animal products; and yet other networks of human descent which shall make higher ultimate uses of the energy stored in plants and in animals and that supplied by mines of coal and oil and by waterfalls, waves, wind, and by direct sunshine.

The living fires of life are to burn brighter with less loss of precious genetic energy. Life itself is to be placed deeper and deeper in the crucible of scientific research. The pure metal is to be saved and the dross is to be discarded. A purified human heredity will aid in developing a better home life, in securing more effective education, and in leading to more effective religious teaching, in the production of superior races in all countries. Freedom from inborn weakness and from evil tendencies inherent in the heredity will be freedom indeed.

But the time will soon have passed when the burden of our efforts should seem to be directed toward showing the importance of the development of heredity and breeding. The time is ripe that we assume that all we have claimed is true, and that we should hereafter turn our attention to methods of work and to securing the means of support for definite projects, that the largest possible results may be secured. To nearly fifty committees of the American Breeders Association have been referred the problems of methods of breeding each class of plants and animals, and the study of heredity in man.

These committees are beginning to frame up plans for the wider coöperation of public departments and experiment stations with associations and individual breeders. They are giving encouragement and even direction to research both as to the laws of heredity and as to methods of creative breeding and the general variety and breed improvement by growers of pedigreed plants and animals.

The Association's Annual Report, wherein are preserved its more scientific papers, and the American Breeders Magazine, its new periodical devoted to the popular phases of genetics, are most efficient agencies for the preservation of the reports of the investigations of genetic science, and are beginning to have a wide influence among practical breeders. This Association has brought into coöperation the genetic scientists of America, and many across both the Atlantic

and the Pacific oceans. It has shown practical breeders that its efforts to bring the work of these scientists to them in its annual meetings and in its publications are successful and worthy of wide support and coöperation. It has organized the investigation of eugenics, so that genetic science is being applied in a most remarkable way to the study of heredity in man. It has not only proven the need but it has organized a basis for a genetics society of a hundred thousand members. "A hundred thousand members and a billion more of farm products annually" will make a good slogan.

The American Breeders Association has been signally honored by the National Corn Exposition in thus setting apart a day as its distinctive day. The management merits great commendation for having developed this exposition so distinctively along lines which blend the economic and the social, the vocational and the educational.

ESTABLISHING A BREED OF ALFALFA FOR THE IRRIGATED LANDS OF COLORADO

W. H. OLIN
Moscow, Idaho

We all realize that alfalfa is one of nature's choicest gifts to man. No plant of such economic value has been studied and grown so many centuries; no forage or grain plant today shows so little breeding as alfalfa. It has many and varying characteristics, and no distinct breed as yet has been firmly and satisfactorily established either in the Old World or the New, although this plant was an established forage plant in Persia before Greece and Rome had a place in history.

More than a decade ago the writer began testing the power of the alfalfa plant to reproduce its foliage and leaf characteristics in its offspring.

He started the alfalfa breeding work at the Iowa Experiment Station and later, at the Colorado Experiment Station, sought with his co-workers—Prof. Fritz Knorr of Fort Collins, Prof. P. K. Blinn of Rocky Ford, and Mr. E. B. House of Greeley, Colo.—to establish for that state a hardy vigorous type of alfalfa with a desirable quality of forage of sufficient yield to render it especially attractive to practical farmers.

Each coöperator used his own plan for obtaining the desired results. To supplement the strains already under investigation the writer secured through Mr. J. M. Westgate, of the U. S. Department

of Agriculture, seed from practically every alfalfa growing nation in the world. Mr. House seeded in rows 30 inches apart. Mr. Blinn seeded in hills 20 inches apart, each way, so the nursery could be cultivated with the beet tillage tools. The writer and Mr. Knorr, at Fort Collins station, seeded in hills 3 feet apart each way. We preferred this latter method because it facilitated isolation in the wire mesh gauze frames which we placed on certain units or plants which were the objects of special study.

Two years were given to the study of types and individual differences, which we found in the various centgeners of the alfalfa nursery. It was observed during the first winter that many plants in certain centgeners were winterkilled, the per cent varying from 2 and 3 to 80. The higher per cent in all three alfalfa nurseries was observed to be in centgeners planted with seed from the warm climate countries. The second winter there was a fine illustration of the "survival of the fittest," all the more tender types practically dying out. We now felt we could begin to determine from these more hardy surviving plants the proper "mother plants" from which to secure the desired breed.

Certain plants were selected for unit study, each having one or more desirable characteristics.

These plants were surrounded with breeding cages of wire mesh fine enough to keep out bees and other insects likely to transfer pollen.

Artificial pollination was practiced on these mother plants and others having desirable traits to transmit to offspring, so that few or no undesirable traits became established in the progeny.

A second series of tests was to determine the percentage of leaf to stem shown by selected plants. First the foliage was cut just as the blossoms began to appear and was weighed green. The foliage was air-cured in a closed room, then weighed again. The leaves were then carefully removed from the stems and weighed. The "green weight" varied from $14\frac{1}{2}$ ounces to 90 ounces per plant. The air-dried weight ranged from $5\frac{3}{8}$ ounces to 28 ounces. The per cent of leaf to stem varied from 23 to 58.

The third series of tests consisted of a study of stem growth and stooling power of the unit plants. At the Fort Collins nursery some 200 plants were deemed worthy of special study the second year. Our first test cut this down to 100, our second test to less than 20, and our third test to but 2 plants, Nos. 15 and 19. These plants seemed to combine the most desirable and the fewest undesirable traits of all the plants under study. For prepotent power, erect

stem growth, width of leaf, and per cent of leaf to stem (53 per cent), the writer chose No. 19 as the ideal mother plant. This was an offspring from Grimm alfalfa which came originally from the Minnesota Experiment Station. Prof. Blinn found his leading mother plant to be No. 7 in centgener F. This plant is a direct descendant of South Dakota No. 167, brought out by Prof. W. A. Wheeler at the Highmore, S. Dak., alfalfa nursery. It came originally from Northern-grown seed, and seems to be identical with the Grimm alfalfa. In the matter of stem growth both No. 7 at the Rocky Ford nursery and No. 19 at the Fort Collins nursery showed better stooling qualities than any other plant and in addition the stems were erect, vigorous, and bore a wealth of bloom and leaves. No. 19 had 10 per cent more stems than any other unit plant under study in the nursery. Where the normal leaf was $\frac{1}{8}$ inch to $\frac{3}{8}$ inch wide and $\frac{5}{8}$ inch to $1\frac{1}{8}$ inch long, No. 19 had leaves from $\frac{3}{8}$ inch to $\frac{5}{8}$ inch wide and 1 inch to $1\frac{3}{8}$ inch long, thus indicating the most *desirable foliage.*

The fourth series of tests was the root test. At the Fort Collins Nursery our work was interrupted by college changes, both Professor Knorr and myself going into other work, and our selected and choice No. 19 as well as our other selections were destroyed, the alfalfa nursery giving way to an oat crop. At Rocky Ford Mr. Blinn continued the breeding work, as did also Mr. House at Greeley.

While Professor Knorr and myself found there was a difference in root maintenance, and some difference in constructive root growth, it remained for Prof. Blinn to find out just what caused that difference in the vitality of various alfalfa plants. This he did in the season of 1910. To satisfy himself that he had really discovered an essential principle and that it was not a local trait, Prof. Blinn visited many alfalfa nurseries throughout the country during the growing season of 1910. He found in each nursery this same trait in the more promising plants. Then he knew he had discovered a most valuable and vital principle in the root growth of alfalfa. It enables him to divide all alfalfa plants into two classes as far as root growth is concerned. All plants, seed for which came from warm climates, have a pronounced tap root, with but few if any side or lateral roots; all plants from Northern or cooler climates have a dominant tap root but carry pronounced and important side or lateral roots.

For this reason if any accident occurs to this tap root, cutting or rotting it off, there remains enough strength in the lateral roots to enable the plant to reëstablish itself. In case of the Southern type the plant dies. Hence we see why this Northern type is so much more vigorous and hardy.

Progeny from No. 19 have been preserved, and this season of 1911 Professor Blinn will determine which shall be the unit mother of the particular breed which he shall propagate for Colorado conditions. The essential traits he seeks to have inherent in this Colorado breed of alfalfa are as follows:

(1) Hardiness or resistance to winterkilling.
(2) Resistance to leaf spot or other foliage diseases.
(3) High percentage of leaf to stem.
(4) Medium-sized leaves and medium-sized stems.
(5) Good seed-producing power.

A definite pedigree will be worked out and an attempt made to keep the strain pure.

From several thousand plants we thus see two plants stand out. These two are almost invaluable because of the inherent possibilities which lie within them.

Each of these plants may produce a progeny that will increase the yield at least 1 ton per acre under field conditions, to say nothing of the improved quality of the hay. This will mean millions of dollars to *Colorado alone each year*, and what must this improvement mean to the nation?

Members of the A. B. A. are urged to encourage Professor Blinn in his efforts to evolve this desirable and much needed breed of alfalfa.

TWINS, HEREDITY, EUGENICS

JOHN H. CHASE
Cambridge, Mass.

There are two kinds of twins; those so much alike that it is hard to tell them apart, especially in youth—called duplicate or identical twins; and those who seem to be no more alike than ordinary brothers and sisters. Some biologists have claimed that identical twins spring from the same germ cell, which becomes accidentally divided, and therefore all qualities which depend on heredity will be the same for these twins. But since environment is almost identical for twins it is hard to separate the qualities produced by their environment from those produced by their heredity. It occurred to us, however, that environment was just as strong for two ordinary twins as for two duplicate twins, and therefore qualities produced by environment should make ordinary twins alike. If duplicate twins are more alike than this, then the "more" is produced by heredity. Perhaps

this residuum—this "more"—if it could be segregated, would solve the problem.

Thinking that this was at least worth investigating, we wrote to the secretaries of about forty American colleges, asking if they would be willing to send the names and addresses of any twins now in college, or any whom they remembered as having graduated. We felt that college men and women would be more interested in the problem, better able to analyze themselves, and more likely to return a questionaire than any other group. We obtained in all the names of about one hundred and fifty pairs of twins, fifty of whom answered. About thirty were "identical," and twenty "ordinary" twins. The questionaire sent to them was as follows:

QUESTIONS ON HEREDITY

No one knows what qualities are inherited, and what are acquired after birth. If we could know exactly, it would be a great advance for science and a great help in education.

It has been discovered that duplicate or similar twins probably occur because the original germ cell is accidentally divided; therefore, duplicate twins arise from the *same* cell. As a result, their inheritance should be the same, and the qualities in which they differ must have arisen after birth. If, then, the twins of the United States are willing to answer certain questions, they may be able to solve one of the greatest problems of science, namely, What part of our nature is due to heredity and what part is due to training?

Would you, therefore, be willing to answer the following questions which will be confidential?

I. PHYSICAL.—(a) Are you and your twin "duplicate twins," namely, during youth, did you look very much alike?

(b) How much do you and your twin differ in height?

(c) Strength: Could you always lift equal weights, or has one always been stronger than the other?

(d) Health: Has one always been more sickly than the other? Have you had the same illnesses?

(e) Look at the palm of your hand; halfway between the end of your finger and the first knuckle, the tiny ridges in your skin twist round into a pattern. Have you and your twin the same pattern for corresponding fingers?

II. MENTAL.—For which *one* of the following subjects have you a special aptitude? (If you both like the same thing, put two crosses in front of it; if your preferences differ, mark the subjects separately.) Only mark one subject—your chief preference and the chief preference of your twin.

(a) Mechanical interest.

(b) Natural science. (Especially fond of nature and animals.)

(c) Business ability.

(d) Musical ability.

(e) Artistic ability or appreciation in any way.

(f) Literary.

III. EMOTIONAL.—(a) Are you equally social? (About the same number of friends.)

(b) Are you equally fond of the opposite sex?

(c) Have you the same interest (or lack of interest) in religious things?

(d) Have you similar dispositions or temperaments?

Do you know of any other twins to whom we could write?

REMARKS.—As far as we know, this is the first investigation of this kind, so if you think of any other likenesses or differences, or distinctive qualities of interest, or have any suggestions, please write them on the other side of this sheet.

NAME:

ADDRESS:

The answers were as follows:

Feature.	Duplicate twins.		Ordinary twins.	
	Alike.	Unlike.	Alike.	Unlike.
Height[a]	20	6	3	12
Strength	22	3	5	7
Health	23	2	5	7
Fingerprints	16	1	2	5
Mental	16	6	2	10
Social	21	1	9	4
Sex attraction	26	1	11	2
Religious	26	2	8	5
Temperament	18	7	4	10

[a] A leeway of half an inch was allowed for crude measurements, high heels, or wavy hair. In the case of strength, health, finger prints, etc., no leeways were allowed.

What results can we glean from these figures? First, that the theory of "identical twins" in the literal sense of the word "identical" is probably disproven. Although duplicate twins are alike, they are not exactly alike, as they should be on the theory of accidental division of the germ cell. Especially sad for this theory is the fact that fundamental qualities such as eye color may vary while all other physical and mental features are duplicated. There seems to be no general law for this variation; the three duplicate twins out of the twenty-four who vary in strength do not include the two who vary in health, although health and strength would seem closely related. Out of the nine features studied there is not a single characteristic which is alike between each pair of duplicate twins. Prof. Edward L. Thorndike gives more elaborate proofs of the same point in his "Measurements of Twins."

But if the theory of identity vanishes, there is another law which seems to emerge and which is the all-important conclusion of our work.

It is this, that, no matter what the physiology, embryology, or metaphysics of twin formation may be, statistics show that duplicate twins are, on the average, three times more apt to be alike than ordinary twins. Now the importance of that law lies in the fact that if duplicate twins are bound by a triple cord of heredity then they give a standard by which we may determine whether any given trait is hereditary or produced by environment; for we can ask a large group of adult twins concerning any given trait. If their answers respond to the 3/4 law the trait in question can be regarded as an hereditary quality, while if not it must be regarded as being produced by environment.

For instance, let us apply the law to the study above. Finger prints, height, strength, health, mental tastes, and temperament are 2.4 to 3.8 times stronger in duplicate than in ordinary twins, which with so few returns is as near the law of three as could be expected. But religious taste, sex attraction, and sociableness are only 1.35 stronger in duplicate than in ordinary twins. Therefore, as far as our returns go, we are warranted in saying heredity has little to do with our religious, or sexual, or social natures; but it is the all-important element in our health, our strength, our temperament, and our mental tastes. Now I do not claim that these results concerning definite things such as religious taste are completely substantiated, for our returns are too few to form final judgments on so important a subject; but I do claim that the above *method* (the law of three) is correct statistically and scientifically for solving and not for theorizing about the great problem of heredity versus environment. It is a method for determining way down into detail the smallest parts of our nature that are inherited. Our study above might not have proven this law, but Dr. Thorndike carried out definite measurements—such as circumference of head, width of head, length of finger joints and forearm, eye color, hair color, word tests, etc.—among 50 New York City school children who were twins, and he found the same law applied among these definite *measurable* factors.

Unlike us, he found difficulty in distinguishing between duplicate and ordinary twins. But Francis Galton found no difficulty on this score, and not a single one of our questionaires was returned with uncertainty on this point, while popular opinion, which is often a good judge on social questions, almost universally recognizes the fact of there being these two types of duplicates and unlike twin.

If, then, the law of three be substantiated, it can be applied to problems, such as the following:

Is cancer transmitted? For instance, if, by an exhaustive questionaire, duplicates were found to be three times as liable as ordinary twins to cancer, then this disease could be considered hereditary. The same method could be used in determining whether consumption was inherited or was simply a tendency. Are certain crimes voluntary or preordained from the time a child is born, and therefore should a given criminal be taken to court or to a hospital?

What are the great hereditary departments of mind and taste that the directors of our vocational bureaus, employers, teachers, and children themselves should know in choosing an occupation? A close study of our returns would seem to show that "art" and "music" should not be separated, while "literary taste" upholds its separate existence as an heredity department, although at first we did not even mention it in the questionaire.

Again, it could be determined through a more exhaustive investigation whether our results concerning health and strength are correct—namely, whether they are dependent almost entirely upon heredity, and very little upon a gymnasium or environment. Francis Galton in his study of twins even concludes that diseases are preordained not only as to their occurrence, but also as to the time at which they will be contracted, because so many of his twins had the same diseases at the same time when in different parts of the country. Our results are not detailed enough to bear on this question, but they do show that health and strength are very dependent upon heredity.

Professor Saleeby says that the reason Greece and Rome and every ancient civilization came to fruition and then declined is that barbarism by its stern life kills the weak; but as civilization advances a chance is given the weaklings to find some little niche in society where they can do a small work and live, and where comforts will sustain their feeble existence and allow them to have children, until finally these weaklings accumulate to such an extent that they are not able to support the civilization that their strong virile ancestors have built up, and the whole structure of society topples over. We could preserve the cumulative good effects of civilization and our own robust lives if we would consciously bring about the breeding of the strong and capable; instead of making it necessary for the weak to be eliminated by natural selective processes; or make it necessary for civilization to return periodically to barbarism in order to be purged.

If it is proven that a predisposition to illness and lack of stamina is inherited, then weak people who know that they will hand on their misery to their children should refrain from marriage, just as at pres-

ent many with a family tendency to insanity are refraining from marriage.

Again if our conclusions be correct, bad tenement houses, child labor, lack of playgrounds, etc., may determine ill health and weakness in a measure, but a weak, degenerate father or mother would be a much larger factor in the result; and if this be true, an over emphasis has been given to these environmental influences as compared to the far more important subjective of hereditary influence. If as much time were spent in forming public opinion and legislation against allowing those of feeble mind, those of feeble body and those with an abnormal hereditary taint to have children, and in encouraging—even by means of a public or private pension if need be—large families among the especially able, public spirited, and strong, then our civilization would be saved, and then our sturdy descendants would be amply able to attend to the matter of forming a pleasant and healthful environment for themselves. For we can probably breed capacity and goodness as well as strength.

In the past it has been objected that there was no way to determine exactly, so as to compel popular assent just what qualities were inherited and to what extent. But twins have now been found to be the magicians who can unravel the skein of this mystery that has puzzled our fathers for generations, and whose solution may now be the means of arousing such a new, practical, workable interest in the new science of eugenics that our present civilization may be saved instead of having to swing like a pendulum back into barbarism. This can be done by having the attention of our philanthropists, women's clubs, reformers, insurgents, the Outlooks, the Surveys, the 15-cent magazines, our Ben Lindsay's, and Roosevelts turned from an almost exclusive study of how to better the world through improving environment to the more important subject of how to better the world by improving the race through the laws of heredity, and by spreading the knowledge of those laws broadcast through society so that the people of America and all other civilized countries will gradually change present customs and practices in conformity with the new knowledge, to the end that the nations may go forward toward a greater physical and mental perfection. If they fail to comprehend this thoroughly, to reform their lines of advance, it is inevitable that within a few hundred years they will have to fall back into fighting barbarism.

Eugenics, with the study of twins as a basis, can be a strong factor in this general advance.

INHERITANCE OF "ACQUIRED EPILEPSY"[a]

Dr. L. B. Alford
Monson State Hospital, Mass.

Brown-Sequard (1860) stated in one of his series of articles on Brown-Sequard "Epilepsy" that he had in a few instances found the condition in the offspring of "epileptic" animals when there had been no operative interference. Westphal (1870) confirmed Brown-Sequard's results, but a number of other observers, including Dr. Taft of the Monson State Hospital (1910), were unable to confirm them.

This work, primarily a study of the nervous mechanism of the phenomenon, has demonstrated that it is the poorly coördinated, simultaneous action of a number of defensive reflexes. These reflexes have become unusually active as a result of frequent repetition. The incoördination following the experimental lesion has rendered the movements ineffective in removing the exciting stimulus, and the constant presence of these stimuli causes many unsuccessful attempts to remove them. By actual count, the number of scratching movements has been found to be greatly increased. The exciting stimuli have been found to be the vermin that infest the bodies of practically all guinea pigs, and when these are removed the "epilepsy" fails to develop or disappears if it is already present. Any lesion that disturbs the most important defensive reflex, the scratch reflex of the hind leg, will be followed by the "epilepsy." Besides cord lesions, and section of the sciatic nerve in the hip, the lesions which Brown-Sequard found sufficient—removal of the toes or even removal of only the distal phalanges—are followed by the condition. This accounts for the presence of "epilepsy" in some of the offspring of Brown-Sequard animals, he having found that in all cases the inherited "epilepsy" was associated with a loss of the toes on the hind feet of the animals.

Anything that affects the reflex condition of the cord has a similar influence on the epilepsy. After spinal irritants such as caffeine and strychnine it can be obtained with greater ease, but following an injection of a small amount of alcohol it quickly disappears. It was found to occur in a more severe form after removal of the higher centers, and can be obtained with great ease after destruction of the cerebellum and section through the lower part of the pons. It may even occur in normal animals after such an operation. It still re-

[a] Read before a meeting of the research committee of the Section of Eugenics, at Palmer, Mass., May 1, 1911.

mains after a double cervical cord lesion, a semisection on one side in the upper cervical and on the other side in the lower cervical regions. After cord lesions movements may occur in an attack in limbs paralyzed for voluntary motion.

Thus not only has the presence of the condition in the offspring of Brown-Sequard's epileptic animals been accounted for, but also the condition itself has been shown to be of such a nature that inheritance would not be expected.

METHODS FOR THE IMPROVEMENT OF SORGHUM

A. H. Leidigh
Kansas State Agricultural College, Manhattan, Kansas

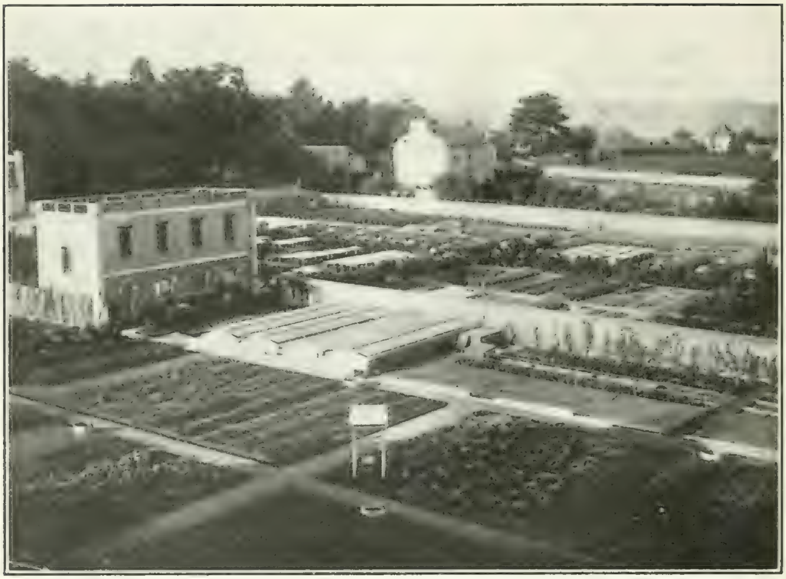
For some fifty years the various sorghums have commanded an increasing amount of attention in the United States. During that time the actual progress in producing sorghum varieties has been made mostly by determining which were adapted to certain localities. With the settling of the non-maize producing districts a greatly increased importance is being given to many types and varieties of the sorghums.

For the past eight years the writer has been associated in various places with projects which have involved the improvement of the adapted sorghums. The results thus far show that very little improvement has ever been accomplished in America. Of the early efforts to increase the sugar contents of the sorghums we can say that no known result remains except from a variety testing standpoint. C. P. Hartley has produced a broom corn cross with sweet sorghum. A. B. Conner, C. R. Ball and the writer have tested varieties and aided in distributing some of them. Dr. C. O. Townsend has done some very definite work on the syrup and sugar sorghums. A. M. Ten Eyck has probably had a better opportunity than anyone else to take up already adapted varieties and increase their usefulness. Each of these men have worked more or less disconnectedly along independent lines. There has been no coördination of ideas and no well defined technique has been developed.

In outlining a project for the improvement of the sorghums at the Kansas Agricultural College the writer has decided to test the production of sorghum from bagged heads. The purpose is to compel self-fertilization. Assuming that these plants are naturally self-fertilized it seems fair to suppose that most of the variations within

a given variety are due to crossing between different plants. If we can eliminate this without reducing the vigor or productivity of the crop we will have made a great step in advance. The work accomplished by Shamel and others on tobacco is probably an illustration of what may be done with sorghums. The writer has assembled data from the men mentioned above. They agree that this group of plants are self-fertilized. Conner, Ball, Ten Eyck, Townsend and the writer have all produced viable seed from flowers protected by bags. Conner, Ten Eyck and Townsend have produced two or more generations of plants from bagged heads. They were forced to resort to bagging because of the proximity of other varieties. That is the work was done simply from necessity. C. R. Ball bagged heads to guard against insects. The writer bagged heads to eliminate danger from head smut at flowering time. Because the work of bagging has been done incidentally very little importance has been attached to it as a practical method for constant use. However, Ten Eyck used it at least four years and some of the strains are now very largely grown over the state with excellent results. Connor states that a particular strain of Orange sorghum which he grew two generations from seed, bagged each year, possessed extraordinary vitality and vigor and was remarkably pure and uniform. Townsend says he has had similar results.

The writer presents these observations here in the hope that this will stimulate experimenters and farmers to test this method. Several men who have had a great deal to do with this crop during the past few years say they are about ready to abandon the head-to-row method of testing varieties or individuals. This they unanimously state is because of cross pollination. They hold that cross pollination practically destroys the identity of the individual strains in a short time. To these men especially I suggest the bagging method. It should make it possible to eliminate the remnant system. It ought to accomplish its purpose whether one variety or hundreds are being grown. The Kansas State Experiment Station has this year started work near the extreme northwestern corner of the state, to produce seed of the sorghums which are adapted to that locality. Kafir and Milo in particular are subject to variations and splitting up when grown there from seed grown in lower or more southern parts of the state. It is hoped that a few years of selection accompanied by bagging the heads before flowering time will give us not only desirable but also uniform types. Seed so grown may probably be used generally throughout that part of the state with much greater success than is now possible with seed not locally grown.



VIEW OF THE FLOWER BREEDING PLOTS ON THE PLANT BREEDING FARM OF ANDRIEUX, VILMORIN AND CO., VERRIERES, FRANCE

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EDITORIALS

THE BREEDING OF MAN

Between methods which may be employed in the improvement of the heredity of the human species and the improvement or modification of other living things there are some decided and fundamental differences. In forms of life lower than man, useful variations can be arbitrarily segregated and multiplied. Thus, a new variety of apple or wheat originating from a single mother plant may supplant all the parent variety in a certain section of a country or even an entire country. Or a new variety of corn, or a new strain or breed of cattle or horses, originating from a group of superior parents, may take the place of the parent variety or breed. No such simple processes, however, are available in the human family. In the present state of information and sentiment we have no means which will encourage the best families to multiply somewhat more rapidly, but the State may place restrictions around marriage of the insane, imbecile, defective, diseased and other racial undesirables and thus by elimination have no less direct influence in bringing up the average heredity of the race. Society may even soon see the wisdom of tabulating the breeding values of all families, thus to emphasize to the strong their racial value, and to the weak their genetic weaknesses and the fatalities which are almost certainly in store for their offspring.

As a matter of fact, society, through charity, helps to keep alive a very large percentage of the weak children of the least successful families; in war we destroy the strongest, most virile of our men; both factors are active in depressing the average value of the racial blood.

Choosing the capable few as the progenitors of a new race, as can be done with plants or animals, and rapidly making their blood that of the race, is impracticable with the human race. On the other hand, something can be done, even if that be quantitatively only a small percentage of what can be accomplished with wheat, cotton, apples, or cattle. For instance, we can arrange to so record the lineage and genetic values of all families that the racial value of each strain of blood may be known; we can privately provide bounties for children born to parents with a superior rating, the bounty to be progressively large as the number in the family increases; we can educate men to avoid venereal diseases, alcohol, and other agencies which decrease their value as parents; and we can be somewhat more exacting in licensing only the fit to marry—and to kill fewer strong men in war.

The throwing together of different racial types develops not only economic and political problems, but eventually hybrid race problems of the most far-reaching character. The hereditary values of the pure races as compared with the hybrid race should be studied from every standpoint.

Records of the performance values of all individuals would soon give data upon which to base the breeding values of each parent; and of estimating the breeding value of each person from whom progeny are not yet available for records on which to base parental values. Thus those families whose genetic values coincide with the average of the racial values would be known; also those families averaging above as well as below the normal for the race. In this manner the particulars in which the best families excel, as well as the lines of weakness of the weaker families, would be available knowledge.

No one can more than conjecture as to whether statistics of good qualities and of faults in the heredity of young people would cause fewer marriages or more marriages on the whole. In reply to those who would argue that the possession of such information would lessen the number of marriages, increase the social evil, and even decrease the production of children, it may be said: The larger proportions of really happy marriages sensibly contracted would make marriage popular. The assurance arising from a better knowledge of both contracting parties as to the success of the issue would lead people to look upon marriage as more certain of a happy ending. Threatened penalties of being ruled out of matrimony on account of unfitness would be a tremendous inducement to lead many persons to courses of rectitude, and to care in preparation for parenthood.

Society and the church would increase their approval of good marriages the issue of which is likely to turn out well. People would in this, as in other affairs of life, do nearly as they are expected to do. The possession of facts would give assurance that an intelligent interest would be taken; and this interest would work out for good. The truth prevails in the light of day.

Well conditioned marriages of people of strong power to succeed in life's affairs and with faith in their eugenic ability to rear strong and healthy children would bring the blessing of at least average sized families. A community made up entirely of successful people would in time have a large surplus of means with which to take the risk of doing well by large families of children. The removal of the fear that children will be defective, weak, sickly, unsuccessful, or will go wrong, will give people both the courage to rear children and the family pride to have a goodly number of children and grandchildren.

SOMETHING MORE THAN THE COMMERCIAL INSTINCT NEEDED

Seldom, if ever, has a man achieved marked success as a breeder of improved live stock who has not perpetually cherished a real fondness for live stock extending far beyond that mere financial interest which dictates to a considerable degree the operations of the majority of men who would be called live stock breeders. Often there lies beneath a rugged exterior of a man, a genius not unlike that of the artist to whose eye every feature and every line in conformation of an animal contributes either to its beauty or ugliness. The imagination of the great artist goes beyond that of the plebeian critic. It takes an artist to appreciate the work of an artist. Just so the achievements of the master breeder are best appreciated by other distinguished breeders.

The meat or milk producer sees nothing in the animal but its ability to produce beef or milk. The breeder demands certain other points of excellence, which for want of a better term may be called embellishments. The breeder has a right to satisfy his tastes in the matter as long as these tastes do not detract from the usefulness of the animal or add materially to its cost. The breeding of pedigreed live stock, without permitting sentiment, embellishment, and "fancy points" to enter into it, is like insisting that four walls and a roof constitute home, or that the farmer should not locate and construct the house and other buildings with reference to making them sightly and attractive. Fancy points should not be encouraged to the exclusion of utility. Utility in improved live stock is fundamental.

Breeders of pedigreed live stock in the United States are no longer scarce but live stock breeders of significant achievement are rare. Many farmers have been inveigled into the breeding of improved live stock by the promise of attractive profits. Reported fabulous prices for individual animals have been the magnet that has led many farmers to abandon the more conservative practices and engage in breeding pedigreed live stock. Only those who have had extended experience in the breeding and sale of improved live stock can fully realize the full cost of the outstanding animal that brings the unusual price, to say nothing of the countless cases where fabulous prices have been reported, which have never been realized except as credited to the breeders' advertising account.—HERBERT W. MUMFORD, *Urbana, Ill.*

GENETIC SURFACE INDICATIONS

Beginning about a third of a century ago, there developed a school of animal breeders with a philosophy which has had an enormous

influence. Its leaders, vigorously but in part thoughtlessly dealing with the genetic economics of our live stock industry, occupied some position as writers most advantageously in touch with the live stock world. Some of these leaders were chosen as judges at fairs and even teachers of animal judging. Their work covered all classes of live stock, including poultry and pet stock.

That school of breeders imagined that in a brilliant and artistic literature of word painting it had a philosophy. The influence of this philosophy has helped to breed out the milking qualities from the heredity of American Shorthorn cattle; held back the dairy development of the Red Poll cattle; kept back improvements in breeding for excellence in egg laying in poultry; delayed the development of tense fiber, endurance, easy keeping, and longevity in our draft horses; and made possible that greatest of all American live stock fiascoes, the Belgian hare craze.

This philosophy enthroned form and fat above genetic power as the criterion of individual excellence in the show or sales ring. Outward signs of excellence usurped a place above inherent breeding power. Centgener tests such as are now used in dairy cattle and speed horse breeding were long laughed out of court by those who spread their philosophy over millions of pages of reportorial and editorial rhetoric concerning beefy draft horses, steers which exhibited the greatest profusion of beautiful lines and curves, porkers whose exteriors of fat padded skins most nearly met the artistic ideal in the mind of the man who happened to be judge that year, and mutton animals with the pre-sheared fleeces. Even the results of such transition tests as milking tests of cows at fairs and egg-laying tests of hens were treated as matters of small import and received but scanty mention. There was a grandiloquent magnification of form which blended with the excitement of the sales and show ring—a manifestation of the excitable character of many of our people.

It would not be true to assert that emphasizing the outward appearance of the individual has not had a very high educational value; or that it has not given the American people vastly higher ideals of excellence to be striven for in animal breeding. It has helped to make possible our live stock fairs and our live stock auction sales; and has been a strong factor in leading many to enter the breeding of pedigreed stock in a large way. It has enormously encouraged the beginner at upgrading his stock, also the beginner at breeding pedigreed stock, to make his start to pay commensurate prices for a pedigreed sire or for a purebred foundation herd. Nor would it be fair to say

that there has been no progress in the breeding of our meat stock and work stock. But it has gone on, not so much because of, as in part in spite of the partial philosophy of those who with voice, pen, brush, and camera have exalted the individual outward appearance above internal genetic power. Some of the progress which has been backward has been largely due to this ingrowing philosophy which has been wedded to a system which yielded "copy," and yielded advertising with accompanying editorial write-ups. The facts and figures developed under the performance record tests, as for instance in advanced registration of dairy breeds, do not require wordy descriptions nor highly colored full-page advertisements to sell the breeding animal whose progeny or close relatives give a high average of production. The trotting horse with very many progeny or other close relatives showing a high record of efficiency in performance on the race track does not need much rhetoric to convince the prospective purchaser of the breeding value of its blood.

The injury done has been in assuming that we already have great excellence in our breeds of meat stock and work stock, because perchance we have an occasional phenomenal individual. When we compare animals of the beef breeds with animals in the advanced registries of the dairy breeds, we see that our meat-producing breeds of live stock have not been subjected to rigid tests for real genetic as well as individual merit, nor have they been improving at so rapid a rate.

The breeders of beef, pork, mutton, poultry, and work stock have already too long assumed that tests of performance, so successfully worked out with dairy cattle, and centgener tests of wheat and corn and other plants, could not be applied to other breeds. These unwarranted assumptions have too long led breeders to depend on the continued importation of choice animals of the breeds created in the British Isles and western Europe, without an effort to do as was done in the old countries and create new breeds and sub-breeds.

But a new movement is in progress, thanks mainly to Mendel and his disciples, and to a school of optimistic plant breeders who for a decade have been devising methods and getting results in creating new varieties of useful plants. Plants which seemingly presented vastly more difficult problems than Hereford cattle, Berkshire swine, Rambouillet sheep, or Shire horses have been brought under performance-record breeding, and newly created varieties are being turned out. The most advanced breeding today, it is safe to say, is done with corn. And the most important and the most difficult features in corn

breeding are applicable to the work of creating new values in the breeds of live stock. In fact, some of these features are being employed by some of the few animal breeders who do really creative breeding.

The writers and teachers of the old school to which reference is here made have been guilty of sins of omission to a marked degree. They have failed to see the most important elements in the philosophy which guided Cruikshank in creating a family which has put short legs and easy feeding quality on Shorthorn cattle, or to see what guided Gentry in producing his record-breaking herd of Berkshires. The word artist who, seeing only the outer appearance of the steer, the sheep, the pig, the draft horse, the nicely pencilled fowl, or the symmetrical ear of corn, has been so blind that he has made the too sweeping generalization that inbreeding is wholly wrong, but which Bates, Cruikshank, the Funks and others have so abundantly disproved. Inbreeding is dangerous when weaknesses are present, but it is a most powerful agency in keeping pure the very best stocks, whether of plants or of animals. By repeated trial Gentry found that his inbred crops of pigs were far better than those resulting from outcrosses, and he was sensible enough to obey the law of nature as practically worked out in the pigs rather than follow a theory which does not apply to all families even of hogs.

Not only has the aforesaid philosophy of the supremacy of form and appearance been in the way of a scientific knowledge on the part of the common breeder of purebred stock, who usually is a multiplier of genetic values secured from others, rather than a creator of new genetic values, but it has been especially harmful in retarding men and associations from undertaking real, constructive, creative breeding.

But the light is breaking. The old school is beginning to see the philosophy of the occasional mutation in the blood of which, if guarded by narrow breeding, there is held the basis for breed improvement. And young men less hopelessly grounded in the principles of the old-time stock sales oration, or stock show editorial, are entering the live stock editorial field. There are even strong rays of hope in poultry editorial circles. The camera is now telling the unexaggerated truth, where formerly the pencil and brush supplied excellence to all flesh indiscriminately.

Animal breeders, in the half century after Darwin put forth his world-changing philosophy in 1859, were practically static. A score of years of scientific and brilliant breeding on the part of plant

breeders about the first of the new century was necessary to awaken them to the vast constructive opportunities in animal breeding. The possibilities from Mendelian recombinations in cross-breeding; the necessity of using vast numbers in creative breeding; the need of collective effort, as in the circuit scheme of animal breeding; the utility of system and order carried out on a large and uniform scale in the effort to create breeds with capacity to yield products at lower cost, and the opportunity for the application of scientific efforts on a large scale, are only the entering wedge. There are many things which portend the rising tide of scientific development in animal and plant breeding, and the mission of the *American Breeders Association* is to lead the van. The totality of heredity of animals in the world, part of which have not yet been imported, and part perhaps as yet untamed, is a mighty force which we can mould better to meet our needs.

Our rich home market for pedigreed live stock, supplemented by the possible foreign market for purebred animals, will make not only possible but relatively easy a great movement in the creation of breeds and families of all kinds of domestic animals whose genetic records will gain for the successful breeders both fame and wealth. The breeders of dairy cattle have only begun to show what can be done all along the line in this and other countries with all classes of farm animals, including fur animals and pet animals as well.

The live stock journals will continue to exploit and conserve the interests vested in the existing commercial herds. And it is well that they should perform that important function. But henceforth there will grow up more facts concerning the inner genetic values of breeds and especially of families within the breeds and the writers, auctioneers, and teachers will thus have figures and genetic pedigrees, which will enable them to conserve and exploit those animals which breed best, rather than merely the prettiest individuals. In fact a change for the better has already taken place in case of species where performance records have longest been recorded.

THE LAW OF VAST NUMBERS

Practical experience in the improvement of living things through breeding demonstrates that the law of vast numbers must be respected. One phase of this law is that one among many is superior as an individual to its fellows. A second phase of this law is that among many of those superior individuals there is one superior also genetically, excelling in its power to transmit its superiority to its off-spring.

In other words, among the thousands or even tens or hundreds of thousands which make up a variety, a breed, or a species there are only a few mutating individuals which transmit marked superiority. A third phase of this law of vast numbers is that to effect general improvement in a variety or breed the progeny of the individuals which prove genetically the best must be multiplied into vast numbers, that they may supplant the individuals which have lower genetic value.

These statements of fact would at first seem hardly worth the dignity of being called laws. But these three facts should be burned into the minds not only of those who try to create new values in plants and animals but also of all genetists, whatever their scientific or practical interests in breeding and heredity.

In part because of disregard of the law of vast numbers and the following of plans numerically narrow, most of the efforts at creative breeding fail to produce stocks which are really valuable or new or represent material advance. On the other hand the relatively large numbers of the really important mutating blood lines which spring up through the everyday work of growers and modest breeders are due primarily to the vast numbers constantly passing under review in everyday production, and as growers become better trained, not only to see mutations but also to seize upon them and subject them to clonal and seminal centgener tests, their discoveries will increase.

Our farms and nurseries for plant breeding as well as our establishments for multiplying superior varieties and breeds of domestic plants and animals should be laid out so that the scientific methods of intermating and selection may be carried out on a large scale. There is here need of largeness of plan and equipment, and the work of the producers, especially the producers of pedigreed plants and animals, should be so systematized that mutations, wherever they arise, may have a chance to gain the eye of someone who will appreciate them and give their blood a genetic opportunity.

Preliminary and preparatory to all nursery work and other technical work in plant breeding, the law of vast numbers should be respected by so testing many varieties as to secure those which may be the best bases for the work of breeding. Large numbers must be used in the nursery in the work of hybridizing and selecting. And to follow the work out to the end of practical trial by growers, a rather large number of the newly formed varieties should be taken from the preliminary trials of the plant-breeding nursery through the field plat trials at numerous trial grounds, as at branch experiment stations.

There is, however, one place where it does not seem wise to adhere to the plan of large numbers, namely, where it comes to distributing new varieties of plants to growers. A few rigidly tested very best varieties will do more good than a larger number of best and second-best varieties thus distributed. A commercial variety enters a complicated set of farm conditions and often a still more complicated set of market conditions. Especially is this true of a product like cotton or wheat; here the method and machinery for the manufacture of the new variety must be readjusted, and in some cases even radically changed. The market must learn of the character and quality of the new potato, apple, or melon, and in some cases the grower must adjust his farm conditions to give the new variety the proper culture or treatment. Thus, in making new tall-growing varieties of flax, it was found that a new scheme of crop rotation was necessary to prepare the land and clean the soil of weed seeds, to avoid the necessity of separating weed fibers from the flax fiber.

In animal breeding the individuals to be used as bases for breed improvement or for the creation of new breeds must be chosen with care from among the very many animals of the foundation breed or component breed which have the largest practical value, first individually and then genetically. The individuals of families which appear best are collected and their genetic value determined in the terms of their progeny; these again are tested and retested generation after generation, so as to eliminate the poor characters and recombine the best characters in a comparatively narrow line of descent worthy of advanced registration on a performance record basis. There must even be provision for bringing into the newly forming sub-breed the blood of superior families which may spring up in the herds of other breeders, just as Williams of Ohio has provided for the introduction into his stocks of pedigreed corn of the blood of corn mutations originating with other breeders.

The animal breeding circuit scheme was devised in part to overcome the disadvantage of the small numbers in private herds, also in part to retain superior blood once it is secured, that it may serve permanently as a source from which superior pedigreed breeding animals may be secured and thus widely disseminated. This plan quite avoids the faults of the course pursued by many wealthy breeders who gather into the one herd some of the best blood of the breed, sometimes securing the progeny of one or more mutating animals and perchance thus securing a collection of animals which if kept together and rather narrowly bred might have a high value as a permanent

source of pedigreed breeding animals. But there is often no one to continue the owner's work, or else his successors lack the genius to maintain high standards, and the herd is dissipated. Thus the circuit scheme, by banding together a group of breeders in a coöperative association and providing for a successor when a member drops out, makes permanent the sub-breed.

Here, as in the selection for distribution of only the very few varieties of plants, the breeding of animals is narrowed down to an interbreeding group, strong physically, efficient in their special functions, prepotent in upgrading and splendid as purebred stock, whether for the production of marketable products—such as meat, milk or wool—or for work.

There are needed plant and animal breeding stations employing technical men in each logical agricultural region, certainly several in each large state. Animal breeding circuits are needed for each breed of horses, sheep, cattle, and swine, and even for poultry. Still other circuits should be very profitable to produce hybrid breeds, as between European and Indian cattle, between cattle and buffalo, between common and fat-tailed sheep; possibly also to produce breeds of deer, foxes, and other semi-domesticated species.

Few men advocate government ownership of purebred stock, and certainly those who now enjoy the individualistic business of pedigreed animal production would not favor turning this business over to governmental agencies. On the other hand, nearly every person agrees that it is the proper function for the federal and state governments to so coöperate with coöperating groups of breeders as to give governmental supervision and aid so as to have scientific plans carried out which will compass all that science can do when large numbers are handled in a scientific way. The greatest example we have of circuit schemes of breeding is the circuit breeding of corn, as centered in the Ohio Experiment Station at Wooster, with which many breeders of pedigreed corn coöperate. Here the public scientists give direction, but the farmers get the educational, inspirational, and economic value of doing the work. The North Dakota Holstein Breeding Circuit is making very satisfactory progress; and the Minnesota Milking Shorthorn Breeding Circuit is doing well, excepting that it lacks the needed large number of herds.

Many people shrink from developing large projects in breeding. But the possibilities along this line are as great as in the public and private irrigation and other engineering projects. There are needed more men who can plan enterprises in breeding, and especially men

who can take these plans and stay by them for the long period of years necessary to get results. The business of breeding plants and animals by scientific organizations only awaits general demonstrations showing the large things which can be accomplished to gain its place as one of the important affairs of public and private interest.

AN OPENING AND A NEED

The editors have received a request to recommend a man trained in genetics as a teacher and researcher in a state university. A man is wanted who is not only strong on animal breeding and well trained in statistical methods, but qualified also to head a department of genetics, to direct the work of assistants, and coöperate with practical breeders.

The fact that such a place goes hunting for the right man brings forcibly to view certain features concerning our animal breeding. The men who breed pedigreed animals, write books on animal breeding, and edit periodicals for animal breeders have been caught napping. They have too long remained content with a philosophy half a century old, which is dim, unscientific, and impractical. These men should rub their eyes and observe that the days of Manly Miles and his book attempting to interpret Darwin's great work have passed. They need to take stock of the new order of things and to look about them for a more scientific and vastly more practical basis for the work of creating new values in our breeds of domestic animals.

Our agricultural colleges are especially in need of developing instruction and research in genetics in relation to the improvement of domestic animals. Our breeders are expending vast sums of money in experiments which, because of a lack of scientific direction, are largely futile. The majority of our farmers are using either scrub stock, grades so crossed as to be often little better than scrubs, or pedigreed animals of indifferent character. That a large number of the latter are thrown out by any efficient system of advanced registration based on performance shows that even the pedigreed breeds are in need of scientific improvement. The results of the Jersey and Holstein advanced registry work are clear proof of the fact that our pedigreed breeds need to be placed on a performance record basis.

The stale contention that the production of meat breeds, breeds of work horses, and dual purpose breeds of sheep and chickens can not be placed on a basis of performance records is finally beginning to give way.

The breeding of corn, cotton, flax, apples, wheat, alfalfa, and other crops is being placed on a scientific basis; yet in each case there were problems which a dozen years ago seemed vastly more difficult than the problem of placing the breeding of Percheron horses, Shorthorn cattle, short-grass-country sheep or such dual purpose chickens as Plymouth Rock on a performance record basis. For our colleges of agriculture to sit idly by and not prevent such monstrous travesties on economic production as the division of a breed into three breeds of different colors instead of applying the same science and energy to the reduction of the cost of meat and eggs is evidence of lack of interest in that line of production. What are our so-called biologists doing that they persist in being "interested" in plant and animal life and not practical in making that life more useful? Why have we not developed more animal husbandry scientists who have seen more deeply into genetics than does the devotee of the show ring and the sales ring, where the phenomenal individual wins over the genetic mutant?

There are signs of a scientific awakening in animal breeding such as occurred in plant breeding a decade ago. As then the plant breeders learned and received inspiration from the animal breeders, so now the animal breeders can learn and gather inspiration from the plant breeders. Those who devote themselves to research in animal heredity especially need to keep in touch with those who experiment with heredity in plants, and those who would devise methods of improving a breed or creating a new breed of animals should study the methods of those who improve varieties of plants, or create new varieties. The deviser of methods for creative animal breeding is especially interested in the methods which are successfully used in creating new values in open-pollinated species, such as corn and cotton; here the process is much the same as in creating new breed values of animals.

Twenty years ago those of us who desired to enter the field of experimental animal breeding found experiment station governing boards and legislative bodies not ready to furnish the necessary large number of animals with which to study the improvement of the heredity of the breeds. Now the situation is very different. The authorities are ready to be shown. Scientific agriculture has so fully made good that this branch of betterment work may now go forward, along with plant breeding, soil improvement, and other leading methods of increasing the production of food at less expense.

In all the state colleges where live stock is a leading interest there is need of a division in charge of live stock breeding, quite unhampered

with general institutional administrative duties. This division should pay especial attention to the education of men who can work as public officers or as private breeders in placing our animal breeding on a scientific basis. It should have large opportunities to give graduates training both in the art and in the science of animal breeding, as in the management of all forms of coöperative breeding, from the mere cow-testing association to the highly developed circuit for breeding the various classes of horses, cattle, sheep, swine, and poultry. Its own experiment station and branch station farm herds often can be most useful parts of the breeding circuit, and in many cases these herds will serve as a means of working out the details to be used on the privately owned herds of the circuit.

The very profitable market for circuit-bred animals bearing a government pedigree based on performance records will eventually become so remunerative to the coöperating breeder and to the state that there will be ample support for research, practical demonstration, and creative work in animal breeding. Numerous young men with instincts both for live stock and for research should take up practical live stock genetics. The demand will not be met in a decade, if in a generation. At present this field offers better openings for careers than forestry, engineering, chemistry, law, medicine, or most other professional lines.

NEWS AND NOTES

ON THE NATURE OF HEREDITY

Since Bakewell pronounced his famous law, "Like begets like," both practical men and scientists have done their best to determine just what heredity is. The original view was that "Heredity is the force which causes offspring to resemble the parents." The tendency to vary was looked upon as a force opposed to heredity. For years this view was held, but the last decade has thrown new light on the subject.

J. Arthur Thomson, in *Heredity,* defines it as the relation existing between an individual and its ancestors or offspring. He has here abandoned the old view that it is a distinct force, but looks on it merely as an existing chain uniting resemblances in different generations. This view has merit, in that it divorces one's mind from the general idea that heredity is a distinct entity or force.

Caspar L. Redfield of Chicago has looked into this subject from the standpoint of an engineer and physicist, and says that heredity is the inertia of living organisms where two or more generations are involved. Transmission is the act of passing this inertia from one generation to the next. Inertia is the tendency of a body in motion to stay in motion or at rest to stay at rest. It is usually applied to non-living matter; but the comparison is apt, as then heredity would represent the inertia of a moving body while the individual is growing, and the inertia of a body at rest when full development is reached. While the comparison is not accepted as absolute, it offers an interesting field for one who would bring his breeding work to mathematical accuracy.

The current belief of biologists at the present time is that heredity is the ability of living matter to react or respond to its environment. Certain definite processes take place in the vital functions of an individual in response to certain causes or stimuli which exist in the environment or surrounding matter. As, for example, spring causes the shedding of the coat in the domestic mammals, and fall and winter produces a heavier one. In this case most mammals respond in a similar way to the same stimulus and in a manner different from reptiles. In the same way we find different responses in different breeds, in different families, and in different individuals. Heredity constitutes a response to the same stimulus in the same way between generations, varieties, breeds, species, etc. Variation then would not

be essentially different from heredity, response either not being so complete or more complete; or else reaction to environment sets an entirely new series of changes at work and a different result ensues. This latter offers a favorable field and does not differ markedly from some other ideas not mentioned except as they are looked at through the eyes of different individuals and from different standpoints. These ideas are most fruitful of future result. Some may criticise this, but if it be remembered that for certain organs and functions the presence and action of other organs and functions corresponds to external stimuli, then a logical phase results throughout. All life processes are physical or chemical in nature and under similar conditions will be always the same.—E. N. WENTWORTH, *Ames, Iowa.*

SIZE OF FARMS AND FARM FAMILIES

The agricultural survey work in Tompkins County, New York, has shown that fair-sized farms, 160 to 300 acres, pay much better than small farms for general farming. Farmers on less than 100 acres are not often doing any better than hired men. The work has now been extended to two other counties with very different conditions, but the same results were found.

The editorial in Volume II, No. 2, of this *Magazine* raises the question of the danger to the character of the citizenship from such a farm. It is suggested that the writers have given too much attention to the economic side and not enough to the social side. We may say that our purpose has been to find out the facts. We have had nothing to do with making the facts. We had no theories to prove. Most of the conclusions have upset any theories that we did have when the work was started. The editorial also gives the impression that such farms call for large numbers of a permanent hired-man class and might go so far as to have only a few landowners in a school district. The following quotations show that no such condition exists or is likely to exist in New York.

This does not mean that large "bonanza" farms are to develop. We have no figures for such farms, as none of them exist in this county. The group of largest farms averages only 261 acres. All the farms are the typical American "family farm," on which the farmer and his family do the major part of the farm work. Even on the farms containing over 200 acres, the family does half of the farm work. These figures may, therefore, be taken as suggesting the most profitable size for a family farm. The larger farms seem to be better than the smaller ones for this purpose. (Page 416.)

These figures do not throw any light on the desirability of the very large farm on which the farmer is so busy managing that he does not do any manual

labor. From observation the writers are of the opinion that such farms have many serious obstacles in their way. They are not likely to be able to handle labor effectively. The farmer who works with his men and directs them as he works, and who treats his hired men as equals, has a great advantage. (Page 416.)

For general farming, these figures show that a farm should contain at least 150 acres. The upper limit of area is determined chiefly by the layout. With ideal conditions, with the buildings in the center of the farm, and with a public road running past the buildings, as high as 600 acres may be run from one center. With more than this area, the distance of the fields from the buildings is usually too great. It is not often that one can secure so large an area well located with respect to buildings. The most profitable general farms in Tompkins and Livingston counties contain about 200 to 300 acres of good land. (Page 427.)

These farms do not call for any permanent hired-man class. On the group of largest farms, even those above 200 acres, the labor is half done by the farmer and members of his family not receiving wages. The unpaid family labor is nearly three times as much as on the small farms. Certainly there is no injury to society from a condition that provides work for the children at home so that they do not have to leave home to find it. In many cases, the hired man is the owner's son who has staid at home because there was a chance. On the small farm there was no such chance; hence, the boys have gone to town or if not entirely disgusted with farming have gone to the larger farms of their neighbors to become hired men. There is no danger to society from a size of farm that calls for one or two hired men on each farm. It takes a number of years to earn money enough to start farming. One or two hired men per farm just about provide places for the young men who are getting started in farming. Certainly there is no danger in a system that provides places for the man with no capital while he is working up. In the regions thus far studied, there are very few men of ordinary intelligence who remain hired men permanently. They pass on to become tenants and owners, to make place for more young men. There are a very few men who will always be hired men because they are not able to manage themselves, either because of lack of ordinary intelligence or because of drink. For such persons, a chance to be a hired-man is a blessing.

It is suggested that small farms with coöperation will solve the problem. There are physical difficulties that cannot be overcome by this means. Too small fields cannot be tilled economically even if you borrow your neighbor's plow. One of the great points in economy is the driving of two, three, and four-horse teams. But such teams cannot work well in small fields even if two neighbors do combine.

The farms themselves must be joined to get the full advantage of economy of production. But partnerships in farming are not often successful; there are too many points on which the two bosses disagree.

I believe that any unprejudiced enthusiast on eugenics, if he could go with us to the three thousand farms that we have studied in various parts of New York, would agree that the family farms of 150 to 300 acres for general farming are much better than the smaller farms from the standpoint of citizenship as well as from the standpoint of profits. Such farms are large enough to permit horses and machinery to be used effectively, and large enough also to give the boys profitable work at home.

No American institution is imperiled. Farmers are merely becoming more efficient. Our Eastern farms were laid out in the days of the grain cradle. The number of men that were then necessary to farm 100 acres can now farm 200 and do it better.—G. F. WARREN *Cornell University, Ithaca, N. Y.*

BREEDING FOR COLOR ADJUSTMENT UNDER CERTAIN CLIMATES

My observations on the effects of light and heat on the organism of animals have elicited some extremely important facts as to the survival value of colors. My former ignorance of the reasons why the Arab horse in a hot climate with his black skin tends to have white hair, and the Chinese pony in a cold climate the same, cost me exactly $200 ten years ago, and if the Government will act on the hint it will save $200,000 in a very short time. Breeders must breed for color where color enhances work, power, and endurance. * * * *

Since then, I have obtained other facts which lead me to believe the matter of color in animals much more important than I formerly thought. The white horse or mule is particularly fitted for climates where the day is hot and the night cool, for by reflecting sun rays it remains comfortable when the black dies of thermic fever; and at night it does not radiate to colder surroundings, remaining comfortable when the black gets pneumonia even though blanketed.—CHAS. E. WOODRUFF, *Surgeon U. S. Army, Panay, P. I.*

THE FOURTH INTERNATIONAL CONFERENCE ON GENETICS

The fourth International Conference on Genetics was held in Paris, September 18 to 23, under the auspices of the National Horticultural Society of France. The preparations for this gathering were commenced more than a year in advance of the date of meeting. A

strong local committee was formed, presided over by Dr. Viger, senator, and president of the National Horticultural Society of France, and with Mr. Philippe de Vilmorin as secretary, to whose untiring efforts a large measure of the success of the conference is due.

About two hundred and forty members were registered and about fifty communications were presented, of which the majority dealt with subjects of a botanical nature. Most of the leading countries in Europe were represented, and delegates were present also from Northern Africa and from the United States and Canada.

It is impossible, within the space of a short notice of this kind, to give abstracts of all the papers presented, and any attempt to select the most important from among them would be undesirable and perhaps futile. It will be sufficient to state that highly important communications bearing on Mendelian theory were presented by such eminent leaders as Bateson, Tschermak, and others, while many papers of a somewhat simpler and more immediately practical character were also given. Some of the communications were illustrated by lantern slides, and others by plain or colored drawings. It is intended that all the papers presented shall be published in full in the volume of proceedings which is to be issued, and where illustrations are of importance these will probably be reproduced. The average quality of the communications presented was certainly of a high order, and although the use of four languages (French, German, English, and Italian) added considerably to the difficulties of the majority of the audience, the papers were received, as a rule, with careful attention and every evidence of appreciation.

Two of the shorter and therefore less conspicuous communications were of special interest to the writer of these notes, and he may therefore, perhaps, be allowed to refer specially to them. Professor von Rumker of Breslau presented very briefly some of the results obtained by him in carrying on selections of rye for color of grain. He exhibited samples of seven different colors, three of which—dark brown, straw yellow, and bright green—now breed true. Dr. Jesenko of Vienna made the interesting announcement that he has succeeded in obtaining a fertile plant by crossing wheat with rye. Although only one seed was obtained from the plant of the first generation, Dr. Jesenko was fortunate enough to obtain one hundred and fifty-two seeds from the plant of the second generation.

In addition to the papers presented before the conference, attention should be called to a pamphlet on genetics by Mr. Philippe de Vilmorin, copies of which were given to all those in attendance at the convention. This excellent little pamphlet gives a brief account of the

origin of the new science of genetics, with a bibliography (classified by subjects) of important publications bearing upon it and a list of all the papers presented at the previous International Conferences namely, London in 1899, New York in 1902, and London in 1906.

From our side of the Atlantic the following papers were presented: W. A. Orton, Obtaining Disease-Resistant Varieties of Plants. F. M. Surface, Results of Selections Among Fluctuating Variations. W. T. Swingle, Variations in the First Generation of Citrus Hybrids. C. E. Saunders, Breeding Varieties of Wheat of High Baking Strength. G. N. Collins and J. H. Kempton, On the Inheritance of Waxy Endosperm in Hybrids of Chinese Corn. These papers, with the exception of that last mentioned, were presented by the authors themselves.

The programme of the conference included five sessions for business of about three hours each, three receptions (by the Horticultural Society, the municipal council and Prince Roland Bonaparte), five excursions and visits to important institutions (to the Pasteur Institutes at Paris and at Garche, to the Vilmorin Trial Grounds at Verrières and to the Veterinary School and the Natural History Museum), and two elaborate repasts (a luncheon at the Vilmorin grounds and a closing banquet at the Continental Hotel.) The social side of the convention was managed with the utmost care and with attention to every detail that good will and hospitality could suggest. Nothing was left undone to make the foreigners feel that they were really guests and friends. The hours for social intercourse proved not only most enjoyable but very profitable, as they afforded opportunities for becoming acquainted with fellow-workers in various parts of the world and for conversation in regard to details of their work which were not presented in their written papers. The closing banquet was an event of which even Paris might well be proud, since it was characterised not only by an admirable menu but by a delightful series of speeches, not one of which was dull or too lengthy, and by a timely adjournment to a smaller room where groups gathered for coffee and conversation and for the saying of farewell.

The request of the American Breeders Association that the next International Conference should be held under their auspices in America was presented to the conference, but no decision was reached in regard to the matter. An influential committee, with Professor Bateson as chairman, was appointed to consider and decide upon the date and place for the next conference. It is not expected that the decision of this committee will be announced for a considerable time.—C. E. SAUNDERS, *Ottawa, Canada.*

A SELF-SEEDING DOUBLE PETUNIA

Mrs. Myrtle Shepherd Francis, member A. B. A., Ventura, Cal., reports the successful production of a self-seeding double petunia. Mrs. Francis, who specializes in breeding this flower, has a collection of over five hundred plants with double blossoms in a variety of colors. Several years ago the originator observed a number of flowers with rudimentary pistils and ovaries and as a matter of experiment pollenized them. After numerous trials she was rewarded with two partially formed seed pods. This year, only five per cent of the flowers grown from seed turned out singles. Selection will probably reduce this to a still lower figure.

Mrs. Francis is developing also a yellow petunia and is working with poppies and the white and red flowering clianthus.

FESTBAND IN COMMEMORATION OF MENDEL

The Naturforschender Verein of Brünn is about to publish a commemorative volume in honor of Gregor Mendel. About a year ago the simple and beautiful Mendel monument was unveiled at Brünn in the presence of a large number of scientists, or, better, Mendelians, and the work in question is proposed to follow as a literary tribute or monument to the great and modest man who has handed to the world the keys with whose aid the outer doors behind which are guarded the secrets of heredity were unlocked. The contents of the Festband follow:

Mendel, Gregor, "Versuche über Pflanzen-Hybriden."

Mendel, Gregor, "Hieracium-Bastarde."

Mendel, Gregor, "Die Windhose vom 13. Oktober 1870."

Baur, Erwin, Berlin, "Ein Fall von Faktorenkoppelung bei Antirrhinum majus."

Cuénot, L., Nancy, "L'Hérédité chez les Souris."

Fruwirth, C. Wien, "Zur Vererbung morphologischer Merkmale bei Hordeum distichum mutans." (Mit 5 Abbildungen auf 2 Tafeln.)

Hagedoorn, L. Arend, Verrières le Buisson, "The Interrelation of Genetic and Non-genetic Factors in Development."

Hurst, C. C., Burbage, England, "Mendelian Characters in Plants, Animals, and Man."

Iltis, Hugo, Brünn, "Vom Mendel-Denkmal und von seiner Enthüllung." (Mit 2 Tafeln.)

Kammerer, Paul, Wien, "Mendelsche Regeln und Vererbung erworbener Eigenschaften."

Nilsson-Ehle, H., Svalöf (Schweden), "Spontanes Wegfallen eines Farbenfaktors beim Hafer." (Mit 4 Figuren.)

Porsch, Otto, Wien, "Die ornithophilen Anpassungen von Antholyza bicolor Gasp." (Mit 2 Tafeln und 1 Textfigur.)

Przibram, Hans, Wien, "Albinismus bei Inzucht."

Roux, Wilhelm, Halle a. d. S., "Über die bei der Vererbung blastogener und somatogener Eigenschaften anzunehmenden Vorgänge."

Semon, Richard, München, "Die somatogene Vererbung im Lichte der Bastard- und Variationsforschung."

Shull, George Harrison, New York, "Defective Inheritance-Ratios in Bursa Hybrids." (Mit 6 Tafeln.)

Tschermak, Erich von, Wien, "Über die Vererbung der Blütezeit bei Erbsen." (Mit 3 Tafeln und 2 Textfiguren.)

PUBLICATIONS RECEIVED

DIE SYSTEMATIK UND METHODIK DER MODERNEN LANDWIRTSCHAFTLICHEN PFANZENPRODUKTIONSLEHRE. Prof. Dr. von Rumker, Breslau. Reprint from Frühlings Landwirtschaftliche Zeitung. 1911. pp. 409–421.

IMPROVEMENT IN CORN. H. K. Hayes and E. M. East. Bulletin 168, Connecticut Agricultural Experiment Station. 21 pp. 4 plates.

This bulletin discusses the methods of producing crosses from distinct types of corn and the value of the seed of those crosses for commercial crops. From tests conducted at the Connecticut station and elsewhere, the authors conclude that the fact of the increased vigor of first-generation hybrids of corn is of commercial importance, and that the project is worthy of further trial.

The Connecticut Agricultural Experiment Station is desirous of entering into coöperation with farmers to thoroughly test the value of first-generation corn hybrids for the production of commercial corn crops.

A comparative test of hybrid and parent varieties, sent in by seven farmers coöperating with the station, resulted in showing that five of the crosses proved beneficial, giving higher yields by from 7 bushels to 44 bushels than the parent varieties grown alongside.

REPORT OF THE BOTANICAL DEPARTMENT, NEW JERSEY AGRICULTURAL COLLEGE EXPERIMENT STATION, 1910. B. H. Alfred Groth, Early J. Owen, Mary Robinson.

Plant heredity studies are reported with beans, corn, eggplants, opra, peas, peppers, squashes, and tomatoes. Plant sap circulation, plant toxicology, and plant shading also receive attention.

HERSELF. Talks with Women Concerning Themselves, E. B. Lowrie, M.D. 221 pp. Illustrated. Forbes and Company, Chicago, Ill.

Herself is the third book in the series of Personal Hygiene books published by an author whose two preceding books received notice

in this department of the *Magazine*. The book before us is fully up to the high standard set by its two predecessors.

So long as our common schools, or extension schools, or schools of personal hygiene, supported by private philanthropic enterprise, do not teach the important facts of the physiology of reproduction, motherhood and heredity, there will be need for such plain commonsense books as this. No attempt is made in this book at being scientific. It is not burdened with descriptive details but emphasizes mostly the instructive features.

There is not in the entire book a term or a phrase which is not written in the plain English of the people. It is replete with sensible advice. One cannot help discovering in this book a sympathetic note coming from a woman whose experience in every stratum of society has led her to realize the need of a publication of this character.

MENDELISM. P. C. Punnett. 173 pp., 35 illustrations, 6 colored plates. Third Edition. McMillan and Company, Ltd., London.

Since the publication of the first edition of this book by the same author in 1905 Mendelism has made remarkable strides. The application of Mendel's Law as originally stated by its author—and, shall we also say, rediscoverers—has been immensely amplified, and as the experimental evidence accumulates the connection becomes clearer that Mendelism furnishes the only key we at present possess to the solution of heredity problems. Not only that, but that with the help of Mendel's Law, genetics, has become practically the only branch of biology, in which it is possible to formulate with almost mathematical conciseness, representations of expectations of heredity processes.

Repeated new editions of this book were really necessary to keep it abreast of advances and in this latest edition Mr. Punnett has not only brought Mendelism up to date but he has given Mendelism a very lucid, concise and direct statement.

In separate chapters are discussed the various phases of Mendelism as understood today. Especially clear is the presentation of the subject of recombination in individuals differing in one, two, three and more pairs of characters. Brief chapters take up the presence and absence theory, interaction of factors, reversion, dominance, wild forms and domestic varieties, repulsion and coupling of factors, sex limited inheritance, variation and evolution and so on, concluding with a chapter on Man and possible application of Mendelism to eugenics.

The reviewer is of the opinion that the general reader of scientific inclinations, as well as the student will find this book valuable as a treatise as well as text book.

ASSOCIATION MATTERS

GROWING POPULARITY OF THE AMERICAN BREEDERS ASSOCIATION

On December 26 last, Dr. A. W. Gilbert, professor of plant breeding at Cornell University, Ithaca, New York, sent in a batch of 102 new members, being mostly members of the New York State Breeders Association. These 102 men are a most welcome addition to the Association, and both the New York State Breeders Association and the American Breeders Association will greatly benefit by this arrangement. The prestige and assistance of the national organization will no doubt be of direct value to the state organization.

The accession of this large number of members of the New York State Breeders Association in a body speaks well for the popularity of the American Breeders Association and is an index of the growing confidence of the practical breeders in the propaganda of the American Breeders Association. Other organizations of live stock breeders are invited to take memberships in the American Breeders Association so that the national organization may rapidly grow to large proportions in order that it may make its work and plans more effective.

THE EIGHTH ANNUAL MEETING

The eighth annual meeting held December 28, 29 and 30 in Washington in affiliation with the American Association for the Advancement of Science was a decided success, in point of attendance, in the number and quality of papers and addresses submitted, and in general interest and enthusiasm. In fact this session surpassed all previous ones in these respects and a good part of our attendance was from scientists belonging to other biological societies.

A large number of new members were enrolled. Mr. T. V. Munson of Denison, Texas, and Dr. Wm. Saunders, Ottawa, Canada, were elected honorary members of the Association.

The Council decided to take steps to organize branch chapters of the Association at all the larger centers of education.

PORTRAITS OF SCIENTISTS AND BREEDERS

There are left a number of copies of the portraits of scientists and breeders, whose biographies were published in the first volume of the *Magazine*. The price of these portraits, which are done in sepia tone on sepia paper, is 10 cents each. A set of these portraits should be framed and hung in every lecture room for plant and animal breeding.

COMPLIMENTARY WORDS FOR THE MAGAZINE

I find the *magazine* very interesting and in fact almost necessary among the breeders of the country. I of course could not afford to be without it or not to be a member of the Association. I shall do what I can in the coming year to further its interests in the enlisting of new members.—GEO. F. FREEMAN, *Tucson, Ariz.*

I enclose check for $2 for renewal of my membership in the Breeders Association, in reversal of my decision of a week since. For I have just read Dr. Van Eedon's article in the August *World's Work*, which has placed the need of eugenics stronger than I ever saw it put before. Two years ago I was interested in the breeding of corn. This has set me to thinking that perhaps the breeding of men is the only hope for the race.—O. E. BAKER, *Madison, Wis.*

We desire to congratulate you upon the splendid *Magazine*, and we wish you all the success so deserving an effort merits.—L. F. BEALE, *Manager, Associated Farm Press, Chicago, Ill.*

I want to say that I consider the last report and the *Magazines* published to be the best ever and that they are worth many times the price of the annual dues.—WM. F. NYE, *San Juan, P. R.*

MEMBERSHIP DUES FOR 1912

Notices of memberships which were due to be paid in the first quarter of 1912 will soon be sent out. Members are respectfully requested to remit promptly and thus save the Secretary's office the expense of later notices.